Aston Martin
Lotus
McLaren
Tesla
Kia
BYD Motors
Toyota
Honda
Mazda
Ford
Subaru
General Motors
Mitsubishi
Nissan
Volkswagen
BMW
Fiat Chrysler
Volvo
Mercedes-Benz
Suzuki
Jaguar
Land Rover
Ferrari
Hyundai

Greenhouse Gas Emission Standards for Light-Duty Vehicles

Manufacturer Performance Report for the 2014 Model Year

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United States Environmental Protection Agency
EPA-420-R-15-026 December 2015

Greenhouse Gas Emission Standards for Light-Duty Vehicles

Manufacturer Performance Report for the 2014 Model Year

NOTICE:

This technical report does not necessarily represent final EPA decisions or positions. It is intended to present technical analysis of issues using data that are currently available. The purpose in the release of such reports is to facilitate the exchange of technical information and to inform the public of technical developments.

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EXECUTIVE SUMMARY

Background

On May 7, 2010, the Environmental Protection Agency (EPA) and the National Highway Traffic Safety Administration (NHTSA) issued a joint Final Rule to establish the first phase of a National Program with new standards for 2012 to 2016 model year light-duty vehicles that reduce greenhouse gas (GHG) emissions and improve fuel economy. These standards apply to passenger cars, light-duty trucks, and medium-duty passenger vehicles. Subsequently, on October 15, 2012, EPA and NHTSA issued standards for GHG emissions and fuel economy of light-duty vehicles for model years 2017–2025, building on the first phase of the joint National Program.

EPA is releasing this report as part of our continuing commitment to provide the public with transparent and timely information about manufacturers' compliance with the GHG program.[1] This report supersedes previous reports and details manufacturers' performance towards meeting GHG standards in the 2014 model year, the third year of the GHG standards which become increasingly stringent in each model year from 2012 through 2025. Some values from previous model years may have changed based on changes or corrections to the historical data. This report is also a reference for users of the GHG credits data, which we are making available in formats appropriate for importing into spreadsheets or database applications.[2]

The following figure illustrates the process and the inputs that determine a manufacturer's compliance with the light-duty vehicle GHG emission standards. Every manufacturer starts at the same place: by measuring the CO_2 tailpipe emissions performance of their vehicles using EPA's City and Highway test procedures (referred to as the "2-cycle" tests). Then they may choose to apply a variety of optional technology-based credits to further reduce their fleet GHG emissions compliance value. The 2-cycle tailpipe CO_2 value, when reduced by the net grams/mile equivalent of the optional credits, determines a manufacturer's model year performance and whether credits or deficits are generated by a manufacturer's model year fleet.

It is important to note that EPA has issued notices of violation to Volkswagen alleging that certain MY 2009-2016 diesel vehicles are in violation of the Clean Air Act for excess oxides of nitrogen emissions (see www.epa.gov/vw). In this report, EPA uses the CO_2 emissions data from the initial certification of these vehicles. Should the investigation and corrective actions yield different CO_2 data, the revised data will be used in future reports.

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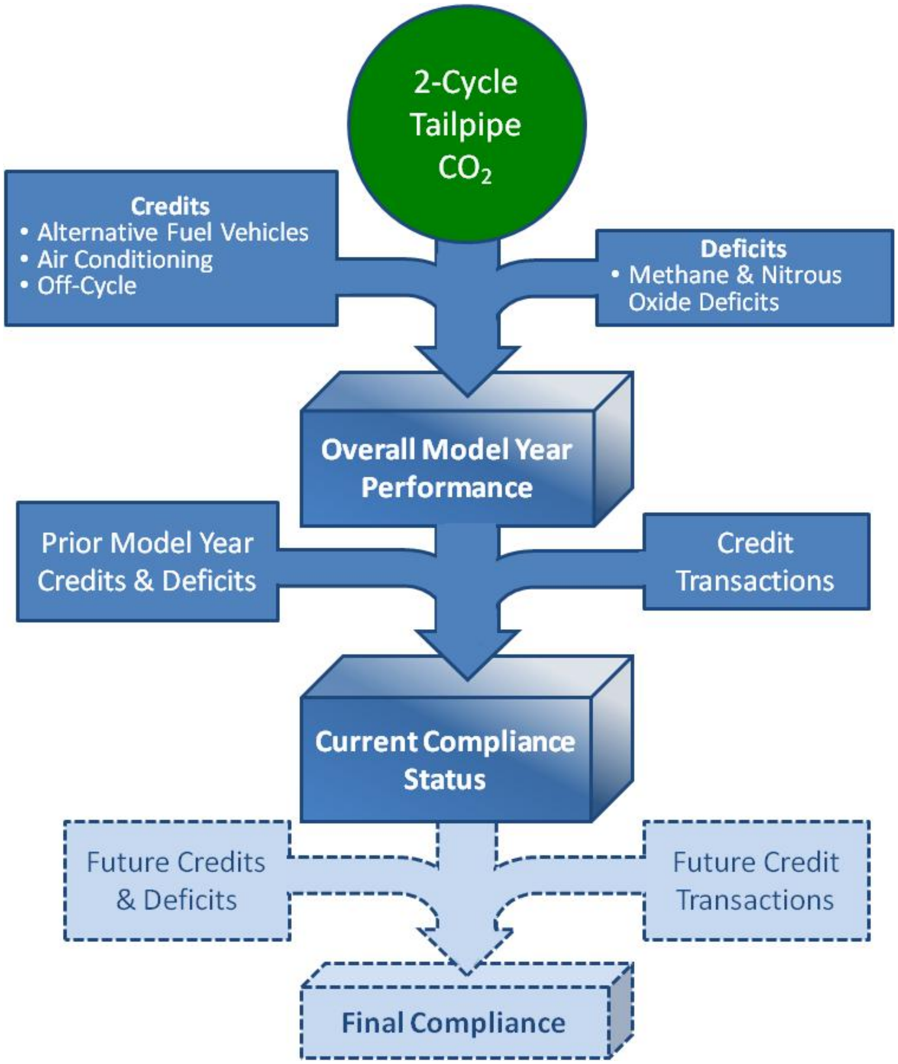
[1] Relevant information on the CAFE program can be found on the NHTSA website: http://www.nhtsa.gov/fuel-economy.

[2] This report and the data upon which it is based can be found and downloaded at http://www3.epa.gov/otaq/climate/ghg-report.htm.

Process for Determining a Manufacturer's Compliance Status

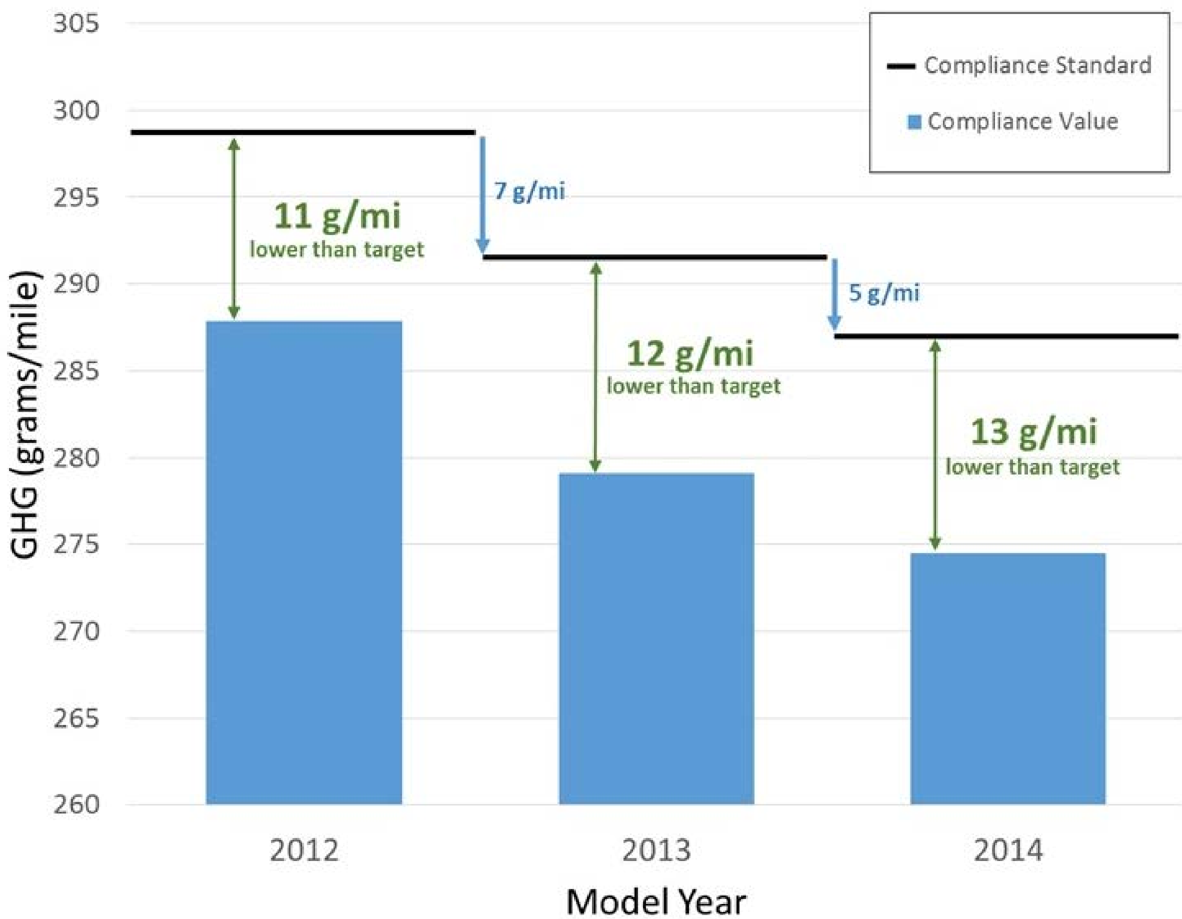


Individual model year performance, however, does not directly determine model year compliance or non-compliance. Manufacturers with deficits in a model year may use credits carried over from a previous model year to offset a deficit. They may also purchase credits from another manufacturer. Manufacturers with a deficit at the conclusion of a model year may also carry that deficit forward into the next model year. Manufacturers must, however, offset any deficit within three years after the model year in which it was generated. After considering these additional credits and deficits, EPA determines a manufacturer's current compliance status. For the 2012 through 2014 model years, there are two ways to describe a manufacturer's compliance status: (1) they have demonstrated compliance, or (2) they have not yet demonstrated compliance. No manufacturer is yet out of compliance with the GHG program in these first three model years; their performance in subsequent years will ultimately determine final compliance.

1 *For the third consecutive year, the auto industry outperformed the GHG standard by a substantial margin*

Overall industry compliance in model year 2014 was 13 grams/mile better than required by the 2014 GHG emissions standard. This marks the third consecutive model year of industry outperforming the standards by a wide margin; industry over-compliance in 2013 was 12 grams/mile and in 2012 was 11 grams/mile better than required. This industry-wide performance means that consumers continue to buy vehicles with lower GHG emissions than required by the EPA standards. See Section 3 for more detail on these values.[3] Manufacturers continued this level of performance against increasingly stringent standards. While the industry-wide GHG standards decreased by 5 grams/mile from 2013 to 2014, manufacturers matched this increase in stringency by reducing compliance values by 5 grams/mile in 2014.

Industry Compliance Values versus Standards in 2012-2014 Model Years

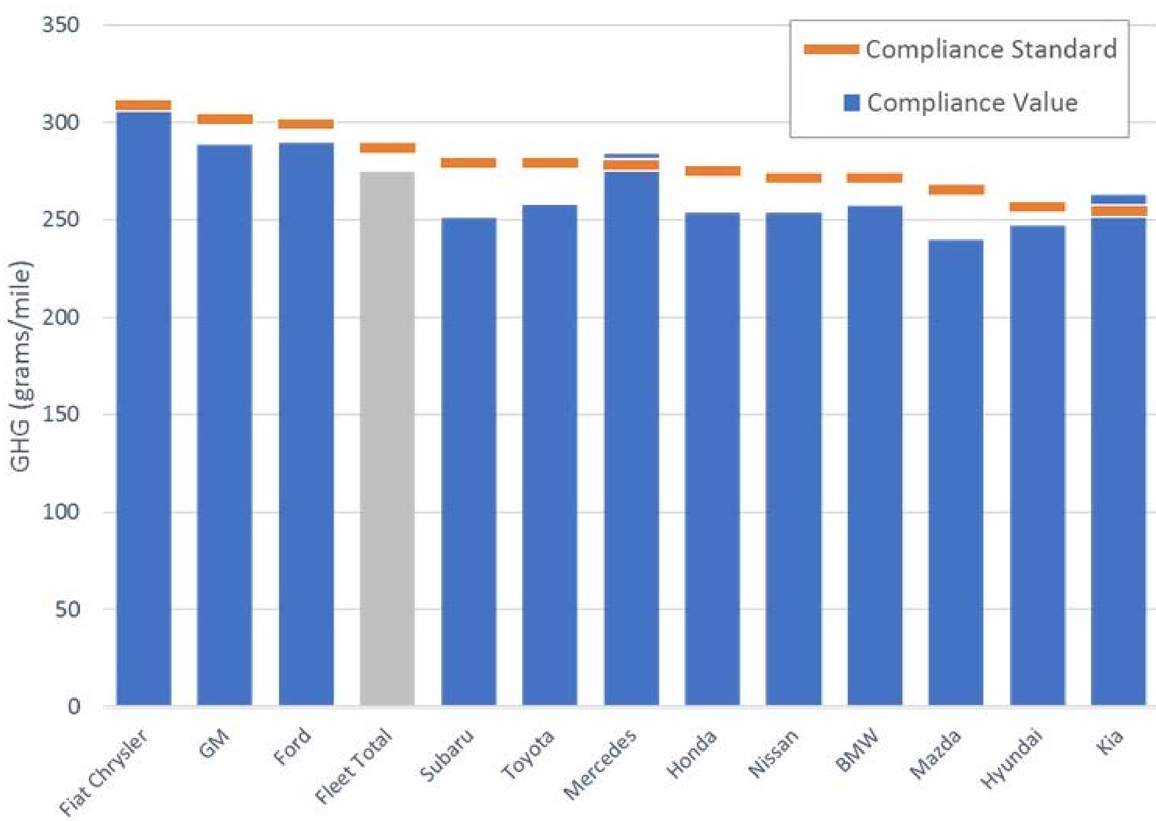


[3] Note that although rounding of the values on the chart may produce some apparent inconsistencies, the numbers reported are correct.

2 *Most manufacturers outperformed their individual 2014 standard*

Most large manufacturers achieved fleet GHG compliance values equal to or lower than required by their unique 2014 standard. Ten of the twelve manufacturers with sales greater than 100,000 vehicles reported meeting or beating their standard, with margins of compliance ranging from 28 grams/mile (Subaru) to exactly meeting their standard with no margin (Fiat Chrysler). Two manufacturers, Mercedes and Kia, missed their unique 2014 standards by 5 and 8 grams/mile, respectively, thus generating deficits in the 2014 model year. More detail about model year 2014 performance is provided in Section 3. The figure below does not include the impact of credit transfers (within a company) reported from prior model years or reported credit trades (transactions between companies), and thus does not portray whether or not a manufacturer has complied with 2014 model year standards. The manufacturers that did not outperform their 2014 standard – Mercedes and Kia – in fact have reported sufficient credits from prior model years to be in compliance with their respective 2014 model year standards.

Manufacturer Compliance Values and Standards in the 2014 Model Year
(from highest to lowest GHG standard)



Note: Volkswagen is not included in this figure due to an ongoing investigation. Based on the original compliance data, Volkswagen's Compliance Standard is 262 grams/mile and their Compliance Value is 261 grams/mile.

3 *All large manufacturers are in compliance with the 2012-2014 GHG standards*

The majority of manufacturers, representing more than 99 percent of U.S. sales, have reported compliance with the standards for the 2012-2014 model years. In fact, 20 of 24 manufacturers are reporting a positive credit balance going into the 2015 model year, meaning that these manufacturers have met the standards in all of the 2012-2014 model years (credits cannot be carried forward if a deficit exists in a prior model year). The manufacturers currently reporting deficits in any or all of the 2012-2014 model years are allowed to carry those deficits forward for three model years, giving them time to generate or purchase credits to demonstrate compliance with the 2012-2014 model year standards. Thus, a manufacturer with a deficit remaining from the 2012 model year has until the end of the 2015 model year to offset that deficit. The current status of manufacturers carrying a deficit into the 2015 model year is neither compliance nor non-compliance – rather, they have not yet fully demonstrated compliance. The makeup of these credit and deficit balances is tracked by model year "vintage" as explained in Section 5.

Credit Balances at Conclusion of the 2014 Model Year (Mg)[4]

(including credit transfers & trades)[5]

Manufacturer	Credits Carried to 2015	Manufacturer	Credits Carried to 2015
Toyota	81,271,823	Suzuki*	428,242
Honda	39,233,010	Mercedes†	228,172
GM	30,380,022	Ferrari	107,613
Ford	27,509,054	Volvo	74,291
Hyundai	19,727,364	Fisker*	46,694
Nissan	17,810,733	Coda*	7,251
Fiat Chrysler	13,759,576	BYD Motors	4,824
Subaru	10,236,711	Tesla	1,965
Kia	9,819,076	Lotus†	(2,841)
Mazda	7,160,086	McLaren†	(6,507)
BMW	1,532,564	Aston Martin†	(35,844)
Mitsubishi	1,333,267	Jaguar Land Rover†	(509,745)
All Manufacturers			**264,868,614**

Note: Volkswagen is not included in this table due to an ongoing investigation. Based on the original compliance data, Volkswagen has a credit balance of 4,751,213 Mg.

†These companies are using a temporary program for limited-volume manufacturers that allows some vehicles to be subject to less stringent standards. See Section 3.B.

*Although these companies produced no vehicles for the U.S. in the most recent model year, the credits generated in previous model years continue to exist.

[4] The Megagram (Mg) is a unit of mass equal to 1000 kilograms. It is also referred to as the metric ton or tonne.

[5] This table does not include unused credits from the 2009 model year, which expired at the end of the 2014 model year. See Section 2 for more information.

4 *Manufacturers continue to reduce GHG emissions while using a wide variety of compliance flexibilities that were designed into the program*

EPA designed the standards with a wide range of flexibilities to allow manufacturers to maintain consumer choice, spur technology innovation, and minimize compliance costs, all while achieving significant GHG reductions. The flexibilities built into the program include standards based on vehicle size (or "footprint"), emissions averaging within car and truck fleets, credit trading between car and truck fleets, optional programs to generate credits through use of GHG-reducing technologies, and processes to bank and/or trade credits. The result is that manufacturers can meet the standards while meeting consumer demand for a wide variety of vehicles, from high-performance vehicles to fuel-efficient hybrids, and from full-size pickups to small cars. In addition, the optional credit programs are facilitating the development and introduction of new technology. For example, manufacturers generated credits for using air conditioning and off-cycle technology credits. Off-cycle technologies included stop-start, active engine and transmission warm-up strategies, high efficiency exterior lighting, and window glazing that reduces solar load to the vehicle's interior volume. Five manufacturers have also now introduced a new and significantly lower-GHG air conditioning refrigerant to the U.S. automotive market, reducing GHG emissions and helping them meet the GHG standards. Credit exchanges within and between companies also provide more flexibility in the program. Sections 2 through 4 provide more details on the use of the credits and flexibilities by each manufacturer.

Use of Compliance Program Flexibilities

		BMW	Fiat Chrysler	Ford	GM	Honda	Hyundai	Kia	Mazda	Mercedes	Nissan	Subaru	Toyota	Volkswagen	Others
Core Design Elements	Footprint Based Targets														
	Car and Truck Standards														
	Fleet Averaging														
Generating Credits	Banked Early Credits	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Air Conditioning	X	X	X	X	X	X	X		X	X	X	X	X	X
	Off-Cycle	X	X	X	X	X	X	X		X	X	X	X		X
	Advanced Technology			X	X	X				X	X		X		X
	Flex Fuel Vehicles		X	X	X					X	X		X	X	X
	CNG Vehicles					X									
Credit Transfers & Trades	Using Banked Credits	X	X		X		X	X	X	X	X	X	X	X	X
	Carrying a Deficit to 2015														X
	Trade: Credits Out					X					X		X		X
	Trade: Credits In		X							X					X
Other	Small Company Provisions														X
	CH4 & N2O Alternative	X	X	X	X									X	

These program elements are integral to the program design and are critical for maintaining consumer choice and reducing compliance costs while achieving significant GHG reductions

1. INTRODUCTION

A. Why Are We Releasing This Information?

We are releasing this report as part of our continuing commitment to provide the public with transparent and timely information about manufacturers' performance under EPA's GHG program. In the two regulatory actions that established the GHG emissions standards for light-duty vehicles, EPA and NHTSA committed to making certain information public regarding the compliance of automobile manufacturers with the CO_2 and fuel economy standards.[6,7] This report is the fourth such report released regarding EPA's GHG program. Previously, in March of 2013 we released a report documenting manufacturers' use of the early credit provisions allowed under the light-duty vehicle GHG program.[8] In April of 2014 we released a report documenting the GHG performance of manufacturers in the 2012 model year, the first year that GHG standards were effective for all manufacturers,[9] and in March of 2015 we released a report documenting GHG performance in the 2013 model year.[10] Because of changes that propagate back to prior model years, such as the buying and selling of credits by manufacturers, prior reports should be considered obsolete and are superseded by this report.

When EPA and NHTSA issued the proposed rule for the 2012-2016 model year CO_2 and fuel economy standards, the proposal received considerable comment about the need for transparency regarding implementation of the program, and specifically, regarding compliance determinations.[11] Many comments emphasized the importance of making GHG compliance information publicly available to ensure such transparency. This was also the case with the proposal for 2017-2025 model year GHG standards, in which we reiterated our commitment to the principle of transparency and to disseminating as much information as we are reasonably, practically, and legally able to provide.[12] In response to the comments on the proposed rule for 2012-2016 model year standards we noted that our public release of data could include "…GHG performance and compliance trends information, such as annual status of credit balances or debits, use of various credit programs, attained fleet average emission levels compared with

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[6] A comprehensive description of the EPA GHG program is beyond the scope of this document, thus readers should consult the regulatory announcements and associated technical documents for a detailed description of the program. See http://www.epa.gov/otaq/climate/regs-light-duty.htm.

[7] NHTSA now provides information to the public regarding fuel economy compliance through a web-accessible public information center. See http://www.nhtsa.gov/CAFE_PIC/CAFE_PIC_Home.htm.

[8] Greenhouse Gas Emission Standards for Light-Duty Automobiles: Status of Early Credit Program for Model Years 2009-2011, Compliance Division, Office of Transportation and Air Quality, U.S. Environmental Protection Agency, Report No. EPA-420-R-13-005, March 2013.

[9] Greenhouse Gas Emission Standards for Light-Duty Vehicles: Manufacturer Performance Report for the 2012 Model Year, Compliance Division, Office of Transportation and Air Quality, U.S. Environmental Protection Agency, Report No. EPA-420-R-14-011, April 2014.

[10] Greenhouse Gas Emission Standards for Light-Duty Vehicles: Manufacturer Performance Report for the 2013 Model Year, Compliance Division, Office of Transportation and Air Quality, U.S. Environmental Protection Agency, Report No. EPA-420-R-15-008a, March 2015.

[11] Proposed Rulemaking to Establish Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards, Proposed Rule, Federal Register 74 (28 September 2009): 49454-49789.

[12] 2017 and Later Model Year Light-Duty Vehicle Greenhouse Gas Emissions and Corporate Average Fuel Economy Standards, Final Rule, Federal Register 77 (15 October 2012): 62889.

standards, and final compliance status for a model year after credit reconciliation occurs" and that we would "…reassess data release needs and opportunities once the program is underway."[13]

In the final rule for model years 2017-2025, we also committed to expanding the information we release regarding GHG program compliance, noting in the preamble that "…EPA intends to publish the applicable fleet average standards (for cars and for trucks) and the actual fleet performance for each manufacturer, and the resulting credits or debits." Further, we stated that we anticipate publishing "…the amount of credits generated by each manufacturer (separately for each of the car and truck fleets) under the optional credit programs, and the associated volumes of vehicles to which those credits apply." We also suggested that we would likely publish credit transactions, as well as the overall credit or debit balance for each manufacturer after taking into account the credit and debit carry-forward provisions and any credit transactions.

In addition to this and prior reports, we continue to release a considerable amount of information regarding fuel economy, emissions, and vehicle characteristics for each vehicle model. For example, starting with the 2013 model year, the downloadable data available at fueleconomy.gov includes CO_2 emission values for each vehicle model. In addition, we release actual vehicle emission test results at epa.gov/otaq/tcldata.htm. Finally, detailed information on long-term industry-wide CO_2, fuel economy, and technology trends since model year 1975 are at epa.gov/otaq/fetrends.htm. This latter report does not contain formal compliance data, but rather focuses on EPA's best estimates of real world CO_2 emissions and fuel economy.

B. What Data Are We Publishing?

The EPA GHG program requires compliance with progressively more stringent GHG standards for the 2012 through 2025 model years. The program includes certain flexibilities, several of which were designed to provide sufficient lead time for manufacturers to make technological improvements and to reduce the overall cost of the program, without compromising overall environmental objectives. The 2014 model year is the third year manufacturers have been subject to the standards. This report makes comparisons across the three complete model years of the GHG program where appropriate. This report supersedes previous reports regarding manufacturer compliance with EPA's GHG program.

The manufacturer-reported data which form the basis for this report was required to be submitted to EPA by May 1 of 2015.[14] The data reported by each manufacturer includes the calculated manufacturer-specific footprint-based CO_2 standard for each vehicle category (car and truck), the actual fleet-average tailpipe performance for each vehicle category (which includes flexible-fuel vehicle credits and credits for other alternative fuels such as compressed natural gas and electricity), the quantity of optional credits (e.g., based on air conditioning or off-cycle technology improvements), credit transfers within a manufacturer between car and truck fleets,

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[13] Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards, Final Rule, Federal Register 75 (7 May 2010): 25469.
[14] See 40 CFR 600.512-12.

credit trades between manufacturers, if applicable, and all the data necessary to calculate these reported values.

This report first updates and summarizes the credits reported by manufacturers under the early credit provisions, and then summarizes the data reported by manufacturers for the 2012-2014 model years in a variety of ways. This includes separately detailing manufacturers' reported use of the flexibilities included in the program (e.g., credits for air conditioning improvements or production of flexible-fuel vehicles), as well as the credit transactions between manufacturers.

Vehicle and fleet average compliance for EPA's GHG program is based on a combination of CO_2, hydrocarbons, and carbon-monoxide emissions (i.e., the carbon-containing exhaust constituents). This is consistent with the carbon balance methodology used to determine fuel consumption for the vehicle labeling and CAFE programs. The regulations account for these total carbon emissions appropriately and refer to the sum of these emissions as the "carbon-related exhaust emissions," or "CREE." The carbon-containing emissions are combined on a CO_2-equivalent basis to determine the CREE value, i.e., adjusting for the relative carbon weight fraction of each specific emission constituent. Although the regulatory text uses the more accurate term "CREE" to represent the CO_2-equivalent sum of carbon emissions, the term CO_2 is used as shorthand throughout this report as a more familiar term for most readers.

The CO_2 standards in EPA's GHG program and the related compliance values in this report differ from the CO_2 values reported in EPA's "Trends" report or on new vehicle fuel economy labels.[15] The Trends report presents CO_2 and fuel economy values that are based on EPA's label methodology, which is designed to provide EPA's best estimate of the fuel economy and GHG emissions that an average driver will achieve in actual real-world driving. EPA's CO_2 standards, like the CAFE standards, are not adjusted to reflect real world driving. Instead, the GHG standards and compliance values are based on the results achieved on EPA's city and highway tests, weighted 55 and 45 percent, respectively. Results from these two tests are commonly referred to as the "2-cycle" test procedures, in that they are based on weighted results from two unique driving cycles. The CO_2 values that appear in the Trends report and on the EPA fuel economy window stickers will be about 25 percent higher than those in this report, and are based on what is frequently referred to as the "5-cycle" methodology, because the results are based on five different test procedures. The 5-cycle methodology includes tests that capture the impacts of aggressive driving, cold temperatures, and hot temperatures with air conditioning operating, among other factors. None of these factors are reflected in the 2-cycle tests used to determine compliance with CAFE and GHG standards.

Credits are expressed throughout this report in units of Megagrams (Mg), which is how credits are reported to EPA by the manufacturers.[16] Further, compliance is ultimately determined based on the balance of Megagrams of credits and/or deficits for a given model year, after accounting for credit transfers and trades. In order to present the impact of these credits in terms that might be more understandable and are comparable equitably across manufacturers, we calculate and

[15] "Light-Duty Automotive Technology, Carbon Dioxide Emissions, and Fuel Economy Trends: 1975 Through 2015," U.S. EPA-420-R-15-016, Office of Transportation and Air Quality, December 2015. See http://epa.gov/otaq/fetrends.htm.

[16] The Megagram (Mg) is a unit of mass equal to 1000 kilograms. It is also referred to as the metric ton or tonne.

present a grams/mile equivalent value where possible (see inset on this page for the methodology used to convert Megagrams to grams/mile).[17] Where such a value in a table applies to a specific manufacturer, the grams/mile value represents the impact of credits on the fleet of that specific manufacturer, whereas the final Fleet Total row displays the grams/mile impact of the total credits across the entire model year fleet of cars, trucks, or combined fleet, whichever may be applicable. Finally, this report does not attempt to summarize or explain all of the elements or details of EPA's GHG program. Readers should consult EPA's final regulations and supporting

How We Determine a Grams/Mile Equivalent from Megagrams (Metric Tons) of Credits and Deficits

The Megagrams (Mg) of credits or deficits reported to EPA are determined from values expressed in grams/mile. For example, fleet average credits/deficits are based on the difference between the fleet standard and the fleet average performance, each of which is expressed in grams/mile. The general form of the equation is:

Credits [Mg] = (CO_2 x VMT x Production) / 1,000,000

"CO_2" represents the credit in grams/mile. "VMT" represents the total lifetime miles, which we specified in the regulations as 195,264 miles for cars and 225,865 for trucks. "Production" represents the production volume to which the CO_2 credit applies.

The CO_2-equivalent of a credit value expressed in Mg is derived by reversing the equation as follows:

CO_2 [grams/mile] = (Credits[Mg] x 1,000,000) / (VMT x Production)

When using this equation to calculate CO_2 grams/mile for aggregate car and truck credits, we use a weighted average of the car and truck VMT values. For example, for the entire 2014 model year fleet covered by this report, the weighted VMT is 207,705 miles. The weighting is by the proportion of cars or trucks relative to the total fleet. The weighting may be applied on a manufacturer-specific basis or across the entire fleet, depending on the data presented in each table. Unless specifically stated, this is always the source of combined car/truck fleet values in this report.

documents for additional information.[18]

C. How Can CO_2 Emissions Credits Be Used?

The ability to earn and bank credits, including early credits, is a fundamental aspect of the program's design, intended to give manufacturers flexibility in meeting the 2012-2016 model year standards, as well as to aid in the transition to the progressively more stringent standards in the 2017-2025 model years. Credits represent excess emission reductions that manufacturers achieve beyond those required by regulation under EPA's program. Credit banking, as well as emissions averaging and credit trading (collectively termed "Averaging, Banking, and Trading",

[17] The quantity of Megagrams generated by a manufacturer is based on production volume, thus, larger manufacturers will produce larger balances of credits or deficits. Because of the connection to production volume, comparing Megagrams across manufacturers isn't meaningful, e.g., a higher volume of credits in Megagrams does not necessarily indicate better performance relative to the standard relative to other manufacturers with fewer credits.

[18] All of the background documents for EPA's GHG regulations are available on EPA's website at http://www.epa.gov/otaq/climate/regs-light-duty.htm.

or "ABT") have been an important part of many mobile source programs under the Clean Air Act. These programs help manufacturers in planning and implementing the orderly phase-in of emissions control technology in their production, consistent with their unique redesign schedules. These provisions are an integral part of the standard-setting itself, and not just an add-on to help reduce costs. In many cases, ABT programs address issues of cost or technical feasibility which might otherwise arise, allowing EPA to set a standard that is more stringent than could be achieved without the flexibility provided by ABT programs. We believe that the net effect of the ABT provisions allows additional flexibility, encourages earlier introduction of emission reduction technologies than might otherwise occur, and does so without reducing the overall effectiveness of the program.

Credits (or deficits) are calculated separately for cars and trucks. If a manufacturer reports a net deficit in either the car or truck category, existing credits must be applied towards that deficit. Although a deficit may be carried forward up to three years, under no circumstances is a manufacturer allowed to carry forward a deficit if they have credits available with which to offset the deficit. If credits remain after addressing any deficits, those credits may be "banked" for use in a future year, or sold or otherwise traded to another manufacturer. Credits earned in the 2010 through 2015 model years may be carried forward and used through the 2021 model year. Credits from the 2009 model year and 2016 and later model years may only be carried forward for five years. Thus, any early credits from the 2009 model year still held by a manufacturer after the 2014 model year have expired and have been removed from the manufacturer's credit bank. In addition, credits from the 2009 model year may only be used within a manufacturer's fleet, and may not be traded to another manufacturer.[19]

D. Which Manufacturers and Vehicles Are Included in This Report?

The vast majority of manufacturers producing cars and light trucks for U.S. sale are currently covered by EPA's GHG program and are included in this report. Small businesses are exempted from the program, and there are other manufacturers included in this report with unique circumstances, as explained below. The report generally uses the common and recognizable names for manufacturers, rather than their formal corporate names; "GM" instead of "General Motors Corporation," "Ford" instead of "Ford Motor Company," Mercedes" instead of "Mercedes-Benz," and so on.

On September 18, 2015, EPA issued a notice of violation of the Clean Air Act to Volkswagen alleging that certain model year 2009-2015 Volkswagen and Audi vehicles equipped with 4-cylinder diesel engines include "defeat device" software that results in up to 40 times higher oxides of nitrogen pollution in real world driving than on EPA emissions tests. On November 2, 2015, EPA issued a second Notice of Violation to Volkswagen alleging that certain model year 2014-2016 Volkswagen, Audi, and Porsche 6-cylinder diesel vehicles are similarly in violation of the Clean Air Act.[20] These alleged violations are now the subject of an ongoing EPA investigation. Oxides of nitrogen emissions are not directly related to tailpipe CO_2 emissions, but

[19] These restrictions for the 2009 model year were established based on concerns that such credits might provide a "windfall" since the California light truck standards from which early credits could be generated are less stringent than the comparable CAFE standards in effect for that model year. See Section 2 for more information.

[20] See www.epa.gov/vw for more information.

corrective actions taken by Volkswagen could impact CO_2 data. In this report, EPA uses the CO_2 emissions data from the initial certification of these vehicles. Should the investigation and corrective actions yield different CO_2 data, the revised data will be used in future reports. Because Volkswagen diesels account for less than 1% of industry production, data changes are expected to have a negligible impact on industry-wide values.

1. Small Businesses

Small businesses are exempt from EPA's GHG standards given that these businesses would face unique challenges in meeting the standards. However, the program allows small businesses to waive their exemption and voluntarily comply with the GHG standards. For example, a small manufacturer of electric vehicles could choose to comply if they were interested in generating GHG credits and potentially participating in the credit market. For the purpose of this exemption, a small business is defined using the criteria of the Small Business Administration (SBA). For vehicle manufacturers, SBA's definition of a small business is any firm with less than 1,000 employees. These businesses account for less than 0.1 percent of the total car and light truck sales in the U.S., thus this exemption has a negligible impact on overall GHG reductions.

2. Small Volume Manufacturers

Similar to small businesses, some very small volume manufacturers (i.e., manufacturers with limited product lines and production volumes that do not meet the SBA definition of a small business) would likely find the GHG standards to be extremely challenging and potentially infeasible. Given the unique feasibility issues faced by these manufacturers, EPA deferred establishing CO_2 standards for model years 2012-2016 for manufacturers with annual U.S. sales of less than 5,000 vehicles.[21]

To be eligible for deferment in each model year, a manufacturer must demonstrate a good faith effort to attempt to secure GHG credits to the extent credits are reasonably available from other manufacturers. Credits, if available, would be used to offset the difference between a company's baseline emissions and what their obligations would be under the GHG footprint-based standards. Three manufacturers – Aston Martin, Lotus, and McLaren – requested and received a conditional exemption for the 2012 model year. Because the 2012 model year was the first model year of the program, and because companies seeking conditional exemptions were required to submit their requests to EPA prior to the start of the 2012 model year, it is not surprising that a credit market had not yet developed, despite inquiries made by these three companies of manufacturers that were holding credits. The only manufacturers with any credits at the time were those with optional early credits, and most were likely awaiting the conclusion of the 2012 model year to better evaluate their ability to sell credits. Because of their conditionally exempt status for the 2012 model year, these three manufacturers were not included in EPA's report that covered that model year.[22] Since then, however, it has become clear that some manufacturers are

[21] The deferment applies only to the fleet average CO_2 standards; these manufacturers are required to meet the applicable nitrous oxide (N_2O) and methane (CH_4) emission standards.
[22] Conditional exemptions are available only through the 2016 model year, after which manufacturers must comply with the GHG program standards or petition EPA for alternative manufacturer-specific GHG standards. The three manufacturers noted here have already submitted applications requesting alternative standards, and EPA is in the process of reviewing those applications.

willing to sell credits, and we have seen a number of credit transactions take place, as described in Section 4 of this report. As a consequence, EPA expects small volume manufacturers may be able to purchase credits and use them to comply with the standards in the 2013 and later model years. No conditional exemptions were approved for the 2014 model year, thus the three companies noted above are included in this report and are expected to comply with the provisions of the program. They may make use of certain flexibilities the program provides for this category of manufacturers, including temporary relaxed standards and the ability to petition EPA for alternative standards.

3. Operationally Independent Manufacturers

Some manufacturers, even though they may be wholly or largely owned by another manufacturer, may consider themselves to be "operationally independent" from the company that owns them. EPA's GHG program contains provisions that allow these manufacturers to seek separate and independent treatment under the GHG standards, rather than be considered as part of their parent company. Manufacturers wishing to obtain operationally independent status are required to submit very detailed information to EPA regarding their business structure, financial operations, manufacturing operations, and management structure. The information in an application for operationally independent status must also be verified by an independent third party qualified to make such evaluations. Ferrari, which was owned by Fiat Chrysler Automobiles (FCA) during the 2014 model year, petitioned EPA for operationally independent status, and EPA granted this status to Ferrari starting with the 2012 model year.[23] As an operationally independent manufacturer with a low U.S. sales volume (2,301 cars in the 2014 model year), Ferrari has the same options as the three small volume manufacturers discussed above. Ferrari has been successful in purchasing credits from other manufacturers to entirely offset their deficits, complying with the 2012-2014 standards and carrying credits into the 2015 model year.

4. Aggregation of Manufacturers

We refer throughout this report to the names of manufacturers at the highest aggregated level, and it may not necessarily be readily apparent who owns whom and which brands, divisions, subsidiaries, or nameplates are included in the results of a given manufacturer. Table 1-1 shows how manufacturers are aggregated based on the ownership relationships and vehicle partnerships in the 2014 model year. Many other manufacturers are covered in the report, but their names and brands are self-explanatory and thus are not shown in Table 1-1.

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[23] Fiat Chrysler Automobiles announced in October 2014 the intention to spin off Ferrari into a separate, shareholder-owned company. At the time of writing this report, the spin-off has been completed and Ferrari is now trading on the New York Stock Exchange as an independent company. For the purpose of this report, however, Ferrari was majority-owned by Fiat Chrysler Automobiles and held operationally independent status for the 2014 model year.

Table 1-1. Aggregation of Manufacturers in the 2014 Model Year

Manufacturer	Manufacturers and Brands Included
BMW	BMW, Mini, Rolls-Royce
Fiat Chrysler[24]	Chrysler, Dodge, Fiat, Jeep, Maserati, Ram
Ford	Ford, Lincoln
GM	Buick, Cadillac, Chevrolet, GMC
Honda	Acura, Honda
Mercedes	Maybach, Mercedes-Benz, Smart
Nissan	Infiniti, Nissan
Toyota	Lexus, Scion, Toyota
Volkswagen[25]	Audi, Bentley, Bugatti, Lamborghini, Porsche, Volkswagen

[24] Ferrari was owned by Fiat Chrysler Automobiles in the 2014 model year. However, due to the approved operational independence status of Ferrari (see Section 1.D.3), Ferrari is treated as a separate manufacturer for the purposes of compliance with the GHG program in the 2014 model year and thus is shown as a separate entity in this report.

[25] In 2009 Volkswagen acquired 49.9 percent of Porsche, and in 2012 purchased the remaining 51.1 percent, resulting in Volkswagen's full ownership of Porsche. EPA regulations allow for a reasonable transition period in the case of mergers such as this, requiring that Volkswagen AG (including Porsche) meet the GHG standards as a single entity "beginning with the model year that is numerically two years greater than the calendar year in which the merger/acquisitions(s) took place." This means that Porsche was considered a separate entity under the GHG program for the 2012 and 2013 model years, but in the 2014 model year is considered part of Volkswagen AG and included in the Volkswagen fleet for compliance purposes.

2. Optional GHG Credits From 2009-2011 Model Years

One of the flexibilities in the GHG program is an optional program that allowed manufacturers with superior greenhouse gas emission reduction performance to generate credits in the 2009-2011 model years. Because this was an optional program, without any compliance implications in these early model years, only those manufacturers that achieved emissions performance beyond that required by existing California or CAFE standards chose to provide data; thus the data does not include information for all manufacturers.

Early credits were earned through tailpipe CO_2 reductions, improvements to air conditioning systems that reduce refrigerant leakage or improve system efficiency, off-cycle credits for the implementation of technologies that reduce CO_2 emissions over driving conditions not captured by the "2-cycle" test procedures, and introduction of advanced technology vehicles (i.e., electric, fuel cell, and plug-in hybrid electric vehicles). The optional early credits program allowed manufacturers to select from four pathways that provided opportunities for early credit generation through over-compliance with a fleet average CO_2 level specified by EPA in the regulations. Manufacturers wishing to earn early credits selected one of these four pathways, and the selected pathway was followed for the three model years of 2009-2011. Since EPA's GHG standards did not begin until model year 2012, EPA established tailpipe CO_2 thresholds below which manufacturers were able to generate early fleet average credits. For two of the pathways, the tailpipe emission levels below which credits were available were equivalent to the GHG standards established by California prior to the adoption of the EPA GHG program. Two additional pathways included tailpipe CO_2 credits based on over-compliance with CO_2 levels equivalent to the CAFE standards in states that did not adopt the California GHG standards. In March of 2013, EPA released a report documenting manufacturers' use of the early credit provisions allowed under the GHG program (the "early credits report").[26]

Table 2-1 summarizes the credits (or deficits) reported by manufacturers in each of the three model years for each participating manufacturer and shows the total net early credits for each manufacturer. The early credits program required that participating manufacturers determine credits for each of the three model years under their selected pathway, and that they carry forward their net credits from the three early years to apply to compliance with EPA's GHG standards in the 2012 and later model years. Thus, even manufacturers with a deficit in one or more of the early model years, (i.e., their tailpipe CO_2 performance was worse than the applicable emissions threshold under the selected pathway) could benefit from the early credits program if their net credits over the three years was a positive value. Manufacturers not listed in Table 2-1 chose not to participate in the early credits program. Additionally, this table is intended to show the credits reported by manufacturers in these years and does not include the impacts of any credit banking or trading on credit balances. In particular, the sale of some early credits by some manufacturers (see Section 4), while not shown in Table 2-1, impacts the

[26] Greenhouse Gas Emission Standards for Light-Duty Automobiles: Status of Early Credit Program for Model Years 2009-2011, Compliance Division, Office of Transportation and Air Quality, U.S. Environmental Protection Agency, Report No. EPA-420-R-13-005, March 2013.

available credit balances of the manufacturers involved in such transactions, as has the use of early credits to offset future model year deficits. Additionally, while credits from the 2009 model year may be used for compliance in 2014, any remaining unused 2009 model year credits will expire and may not be carried forward into the 2015 model year. Table 2-2 shows the total early credits reported by each participating manufacturer, broken down by the type of credit reported. Note that the early credits program did not include credits for flexible-fuel vehicles, whereas these credits are permitted in the 2012-2015 model years.

Table 2-1. Total Early Credits, by Manufacturer and Model Year (Mg)

Manufacturer	2009*	2010	2011	Total
Aston Martin	1,547	676	1,109	3,332
BMW	445,683	308,490	250,119	1,004,292
Fiat Chrysler	5,926,979	4,833,763	(1,650,535)	9,110,207
Ford	8,358,440	7,416,966	300,482	16,075,888
GM	13,009,374	11,073,134	482,321	24,564,829
Honda	14,133,353	14,182,429	7,539,750	35,855,532
Hyundai	4,605,933	5,388,593	4,012,969	14,007,495
Kia	3,134,775	2,651,872	4,657,545	10,444,192
Mazda	1,405,721	3,201,708	875,213	5,482,642
Mercedes	96,467	124,120	157,685	378,272
Mitsubishi	625,166	521,776	302,394	1,449,336
Nissan	10,496,712	5,781,739	1,852,749	18,131,200
Subaru	1,620,769	2,225,296	1,909,106	5,755,171
Suzuki	448,408	329,382	98,860	876,650
Tesla	0	35,580	14,192	49,772
Toyota	31,325,738	34,457,797	14,651,963	80,435,498
Volvo	194,289	359,436	176,462	730,187
Total	**98,072,559**	**95,704,420**	**37,018,921**	**230,795,900**

Note: Volkswagen is not included in this table due to an ongoing investigation. Based on the original compliance data, Volkswagen generated early credits of 2,243,205 Mg in 2009, 2,811,663 Mg in 2010, and 1,386,537 in 2011, for a total of 6,441,405 Mg.

*Credits from the 2009 model year not used to offset deficits in the 2012-2014 model years expired at the end of the 2014 model year and will be removed from a manufacturer's credit bank.

Table 2-2. Total Reported Early Credits, By Credit Category

Credit Category	Credits (Mg)	Percent of Total (%)
Tailpipe CO_2*	198,792,034	86%
A/C Leakage	23,431,724	10%
A/C Efficiency	8,566,510	4%
Off-Cycle	5,632	0%
Total	**230,795,900**	**100%**

*Tailpipe CO_2 credits in the early credits program do not include credits from flexible fuel vehicles.

Early credits from advanced technology vehicles (electric vehicles, plug-in hybrid electric vehicles, and fuel cell vehicles) may be included in Table 2-2, depending upon how the manufacturer chose to account for them. In these early credit years, manufacturers producing advanced technology vehicles had two options available to them. They could simply incorporate these vehicles into their fleet averaging in the relevant model year calculations using zero grams/mile to represent the operation using grid electricity (see the discussion of advanced technology vehicles in Section 3.C for more information regarding this incentive). Alternatively, the program allowed manufacturers to exclude them from their fleet average in the 2009-2011 model years and carry the vehicles forward into a future model year, where they must be used to offset a GHG deficit. Four manufacturers had qualifying vehicles in the 2009-2011 model years. GM and Mercedes chose the latter approach, while Nissan and Tesla chose the former approach. Advanced technology vehicle credits are discussed in more detail in Section 3.C which also shows the production volumes of advanced technology vehicles for the 2009-2014 model years.

Due to concerns expressed by stakeholders during the rulemaking process, EPA placed certain regulatory restrictions on credits from the 2009 model year.[27] Specifically, 2009 model year credits may not be traded to another company, and they retained a 5 year credit life. Thus, any unused 2009 model year credits expired at the end of the 2014 model year. Table 2-3 shows the credits left unused by each manufacturer at the end of the 2014 model year. These credits may not be carried forward to the 2015 model year, and shall be removed from each manufacturer's bank of credits. Note that of the 98 million Mg of 2009 credits earned by manufacturers, almost 75 million Mg, or about 75 percent, were never used and have now expired. The expired credits also amount to about one third of the total early credits accumulated by manufacturers in the 2009-2011 model years.

Table 2-3. Expired 2009 Model Year Credits

Manufacturer	Credits (Mg)
Toyota	29,523,399
Honda	14,133,353
Nissan	8,190,124
GM	6,473,623
Ford	5,882,011
Hyundai	4,476,176
Kia	2,282,680
Mazda	1,390,883
VW	1,150,976
Mitsubishi	583,146
Subaru	491,789
Suzuki	265,311
Total	**74,843,471**

[27] Light-Duty Vehicle Greenhouse Gas Emissions and Corporate Average Fuel Economy Standards, Final Rule, Federal Register 75 (7 May 2010): 25324, 25328.

Again, previous EPA reports regarding EPA's GHG program should serve only as historical references that are superseded by later reports. Each report is based on the best available data at the time of publication. This report regarding the 2014 model year, and the accompanying data as reported by manufacturers for the 2009-2014 model years, should be used as the references from which to determine credit balances and overall performance at the conclusion of the 2014 model year, and prior reports should generally be considered obsolete.

3. Credits Reported From the 2012-2014 Model Years

The mandatory compliance calculations that manufacturers must perform are (1) to determine credits or deficits based on manufacturer-specific, vehicle footprint-based CO_2 standards for both car and truck fleets, and (2) to demonstrate compliance with N_2O (nitrous oxide) and CH_4 (methane) exhaust emission standards. Compliance with CO_2 standards is assessed separately for car and truck fleets at the end of each model year, using emission standards and fleet average values determined based on the sales-weighted actual production volumes of the model year. Compliance with N_2O and CH_4 standards is typically done in conjunction with emission tests for other pollutants, although there are additional options as described later in this report.

Although the minimum requirement is that manufacturers calculate credits (or deficits) based on fleet average tailpipe CO_2 emissions, manufacturers have several options to generate additional credits as part of their overall strategy to reduce GHG emissions and meet the standards. These options are described in detail in this report, and include credits for gasoline-ethanol flexible fuel vehicles, improvements to air conditioning systems that increase efficiency and reduce refrigerant leakage, reductions in emissions that aren't captured on EPA tests ("off-cycle" emissions), transitional alternative standards (for eligible low-volume manufacturers), and advanced technology vehicle incentives. The use of the optional credit provisions varies from manufacturer to manufacturer (some manufacturers have not availed themselves of the extra credit options, while others have used some combination of, or all, options available under the regulations). Although a manufacturer's use of the credit programs is optional, EPA projected that the standards would be met on a fleet-wide basis by using a combination of reductions in tailpipe CO_2 and use of the additional optional credit and incentive provisions in the regulations.

Compliance with the EPA GHG program is achieved with the use of many different building blocks, starting with tailpipe emissions levels and, depending on need, strategy, and technology development and availability, employing one or more credit or incentive programs as additional elements contributing to compliance. Depending on the manufacturer, some of these credit and incentive building blocks may or may not be used. However, all manufacturers start with the same two mandatory building blocks: (1) GHG emissions on a grams/mile basis as measured on EPA test procedures for each vehicle model, and (2) fleet-specific grams/mile CO_2 standards based on the footprint of models produced in each car and truck fleet in a given model year. If a manufacturer uses no credits, incentive programs, or alternative standards (if applicable), then we can assess compliance by comparing the production-weighted fleet average emissions from the emission tests with the fleet-specific footprint-based standards. However, most manufacturers are using some credits, incentives, or alternative standards (if applicable), thus for those manufacturers (and for the aggregated fleet as a whole) these building blocks must be accounted for before determining whether or not a standard is met. Indeed, EPA's rulemaking analysis projected that the use of credits and incentive programs was expected to be an integral part of achieving compliance, especially in the early years of the program.

We begin by discussing the "2-cycle" tailpipe GHG emissions value (Section 3.A), which is the starting point for compliance for every manufacturer. We then detail each of the different credit and incentive programs, distilling each to an overall grams/mile impact for each manufacturer.

> **IMPORTANT NOTE REGARDING TABLES**
> Many of tables in this section have a final row labeled "Fleet Total" This row indicates a value that is calculated based on the entire model year fleet and is not specific only to the manufacturers listed in the table. For example, not all manufacturers generated credits for air conditioning systems, but the final "Fleet Total" row in those tables indicates values that are calculated to show the impact of air conditioning credits on the entire model year fleet (i.e., across all manufacturers, whether or not they reported air conditioning credits).

Section 3.B describes the temporary lead time allowance alternative standards (TLAAS); Section 3.C describes alternative fuel vehicle incentives, including the temporary flexible fuel vehicle incentives; Section 3.D describes credits based on air conditioning system improvements; Section 3.E describes off-cycle emission reductions; and Section 3.F discusses the impact of alternative methane and nitrous oxide standards. Once these values have been determined, the 2-cycle tailpipe value is reduced by the total of all the credit and incentive programs to determine a "compliance value," as described in Section 3.G. Section 3.H describes the derivation of manufacturer-specific CO_2 standards, which leads into Section 3.I, which concludes Section 3, by comparing the compliance values to the CO_2 standards to determine whether or not a given fleet generates credits or deficits in the 2014 model year. We also show results aggregated on an industry-wide car and light truck fleet basis and an industry-wide total combined fleet basis for informational purposes.

This report approaches the description of manufacturer compliance in the same manner as did the report for the 2013 model year. Instead of focusing on Megagrams of credits and deficits (which is how credits are reported to EPA by the manufacturers), this report describes compliance (for each manufacturer's car, truck, and combined fleets, as well as for the aggregated industry) by describing each of the building blocks of compliance and the grams/mile contribution to a manufacturer's total compliance. However, note that the grams/mile values are calculated only for the purpose of this report, and are not specific compliance values defined in the regulations.

A. "2-Cycle" Tailpipe CO_2 Emissions

The starting point for each manufacturer is to test their vehicles on two test procedures defined in EPA regulations: the Federal Test Procedure (known as the "City" test) and the Highway Fuel Economy Test (the "Highway" test). These tests produce the raw emissions data reported to EPA, which is then augmented by air conditioning credits, off-cycle credits, incentives for dual fuel vehicles, and other provisions, to produce the total compliance picture for a manufacturer's fleet. Results from these two tests are averaged together, weighting the City results by 55% and the Highway results by 45%, to achieve a single value for each vehicle model produced by a manufacturer. A sales-weighted average of all of the combined city/highway tailpipe values is calculated for each passenger car and light truck fleet and reported to EPA. This value represents the actual tailpipe CO_2 emissions of a fleet without the application of any additional credits or incentives, and as such, comparison with a fleet-specific CO_2 standard would be inappropriate.

Table 3-1 shows the 2-cycle tailpipe emissions for the car, truck and combined fleets reported by each manufacturer for the 2012-2014 model years.[28] Absent the use of credits and incentives, manufacturers demonstrated overall reductions in tailpipe GHG emissions in both the car and truck categories in 2014 relative to 2013. Manufacturers were split almost evenly between those with an increase and those demonstrating a decrease in 2-cycle GHG emissions relative to model year 2013. Across the industry, a small reduction in 2-cycle GHG emissions from cars (1 g/mi) and a sizeable reduction in 2-cycle emissions from trucks (10 g/mi) led to a net of no change in overall fleet-wide 2-cycle emissions. Despite the reductions in car and truck emissions, the fleet 2-cycle emissions overall did not change from 2013 to 2014 because of an industry-wide increase in truck production in the 2014 model year to 41 percent of the fleet, up from 36 percent relative to the 2013 model year fleet (see Appendix A for car and truck production data).

On a percentage basis the most significant reductions from the 2013 to the 2014 model year were reported by Mitsubishi (-8.8%), BMW (-7.6%), and Jaguar Land Rover (-6.0%). Both Hyundai and Kia reported increases in fleet CO_2 emissions, but those appear to be largely due to unusual division of production volume for those companies across the 2013 and 2014 model years. Hyundai passenger cars, particularly some of their low-GHG models, had a long production model year in 2013 and a short 2014 model year. As a result, Hyundai's production of cars was over 1 million units in the 2013 model year, then dropped to about half that in the 2014 model year, while truck production remained steady across the two model years. In addition to this unusual distribution across model years, and as was the case in the 2013 model year, the impact of shifts in car and truck production can be seen in the 2-cycle data (see Appendix A for car and truck production volume data). For example, note that Ford did not reduce emissions from either their car or truck fleets, yet reported an overall combined fleet reduction of 6 g/mi. This derives from a shift from 49 percent cars in the 2013 model year to 54 percent cars in the 2014 model year (the opposite of the industry-wide trend from 2013 to 2014).

[28] The values in Table 3-1 do not include the impacts of credits or incentives resulting from FFVs, CNG vehicles, air conditioning improvements, and off-cycle technologies. The impacts of these are detailed in subsequent sections. The values also reflect that direct tailpipe GHG emissions from electricity are zero. Because the values in this table do not include these credits and incentives, the table does not describe a manufacturer's actual model year performance or a manufacturer's compliance status.

Table 3-1. "2-cycle" Tailpipe CO2 Production-Weighted Fleet Average Emissions (g/mi)

Manufacturer	Model Year 2012			Model Year 2013			Model Year 2014			Change, 2013 to 2014		
	Cars	Trucks	All	Cars	Trucks	All	Cars	Trucks	All	Cars	Trucks	All
Aston Martin[A]				444		444	454		454	10		10
BMW	277	363	302	271	346	292	256	312	270	-15	-34	-22
BYD Motors	0		0	0		0	0		0	0		0
Coda[B]	0		0	0		0						
Ferrari	494		494	475		475	484		484	9		9
Fiat Chrysler	300	384	357	289	380	344	298	364	346	9	-16	2
Fisker[B]	146		146									
Ford	261	385	315	256	375	321	256	375	315	0	0	-6
GM	283	397	331	273	395	325	266	369	314	-7	-26	-11
Honda	237	320	266	228	312	257	228	299	259	0	-13	2
Hyundai	243	312	249	238	317	241	247	325	253	9	8	12
Jaguar Land Rover	376	439	426	345	414	399	347	379	374	2	-35	-24
Kia	258	324	266	252	301	254	265	330	269	13	29	15
Lotus[A]				334		334	338		338	4		4
Mazda	241	324	263	232	296	251	220	287	240	-12	-9	-11
McLaren[A]				374		374	372		372	-2		-2
Mercedes	316	393	343	296	371	321	285	372	309	-11	1	-12
Mitsubishi	262	283	267	254	267	258	224	256	236	-30	-11	-23
Nissan	258	382	295	232	340	266	229	335	263	-3	-5	-3
Porsche[C]	325	362	342	309	363	336						
Subaru	257	296	282	254	270	264	250	254	253	-4	-16	-11
Suzuki[B]	267	361	287	266	330	273						
Tesla	0		0	0		0	0		0	0		0
Toyota	221	354	273	224	347	278	221	358	274	-3	11	-4
Volvo	297	343	311	292	348	318	288	348	319	-4	0	1
Fleet Total	**259**	**369**	**302**	**251**	**360**	**294**	**250**	**349**	**294**	**-1**	**-10**	**0**

Note: Volkswagen is not included in this table due to an ongoing investigation. Based on the original compliance data, Volkswagen's 2014 model year 2-cycle tailpipe values are 266 g/mi for cars, 336 g/mi for trucks, and 280 g/mi for the combined fleet.

[A] *Exempt from compliance with 2012 model year standards.*

[B] *No production in 2013 and/or 2014 model years.*

[C] *Starting with the 2014 model year, Porsche vehicles are incorporated into Volkswagen.*

B. TLAAS Program Standards

EPA established the Temporary Lead-time Allowance Alternative Standards (TLAAS) to assist manufacturers with limited product lines that may be especially challenged in the early years of EPA's GHG program. The TLAAS program was established to provide additional lead-time for manufacturers with narrow product offerings which may not be able to take full advantage of averaging or other program flexibilities due to the limited scope of the types of vehicles they sell. In the 2012 model year the program was used by Ferrari, Jaguar Land Rover, Mercedes, and Porsche. Aston Martin, Lotus, and McLaren – companies that were exempt from the 2012 standards under the program's small volume manufacturer provisions – joined the program in the 2013 model year and incorporated use of the TLAAS standards in their 2013 and 2014 model year compliance.

The TLAAS program applies only to manufacturers with 2009 model year U.S. sales of less than 400,000 vehicles, and, except as noted below, is available during the 2012-2015 model years. Under this program, a manufacturer is allowed to treat a portion of its fleet as a separate averaging fleet to which a less stringent CO_2 standard applies. Specifically, a qualifying manufacturer may place up to 100,000 vehicles (combined cars and trucks) under the less stringent standards over the four model years from 2012 through 2015 (i.e., this is a total allowance, not an annual allowance). The CO_2 standard applied to this limited fleet is 1.25 times – or 25 percent higher than – the standard that would otherwise be calculated for the fleet under the primary program. Manufacturers with 2009 model year U.S. sales of less than 50,000 vehicles are allowed an additional 150,000 vehicles (for a total of 250,000 vehicles at the 25 percent higher standard), and can extend the program through the 2016 model year (for a total eligibility of five model years).

All manufacturers participating in the TLAAS program are subject to a number of restrictions designed to ensure its use only by those manufacturers that truly need it. Manufacturers using the TLAAS program may not sell credits, they may not bank credits that are accrued by their non-TLAAS fleets, they must use up any banked credits before utilizing a TLAAS fleet, and the movement of credits between a manufacturer's TLAAS and non-TLAAS fleets is restricted.

There are four possible fleets for emissions averaging and credit or deficit calculation under the TLAAS program: both cars and trucks in either the Primary or TLAAS program. Manufacturers employed a variety of strategies in the use of the TLAAS program in the 2012 through 2014 model years. The smallest-volume companies (Aston Martin, Ferrari, Lotus, and McLaren) placed all of their 2013 and 2014 production into a TLAAS fleet, because they can do so without any risk of exceeding the applicable limits. Porsche, which placed all of its 2012 and 2013 vehicles in the TLAAS program to date (totaling more than 70,000 vehicles), would reach the 100,000 vehicle limit in the 2014 model year except for the fact that they are now aggregated with the Volkswagen fleet in the 2014 model year and no longer eligible to use the TLAAS program.

Table 3-2 shows each manufacturer's reported use of the TLAAS program for the 2012-2014 model years. Note that the total of 286,740 vehicles placed under the less stringent standards in the program to date represents less than one percent of the total vehicles produced in the 2012-2014 model years.

While required by the regulations, the complexity of reporting credits and deficits in Megagrams of CO_2 can sometimes obscure the progress that companies are actually making towards reducing their GHG emissions. The approach we have developed in this report provides the transparency needed to be able to make these evaluations. For example, Mercedes-Benz and Jaguar Land Rover, the largest of the manufacturers using these temporary and limited alternative standards, have both made substantial progress reducing tailpipe GHG emissions from 2012 to 2014. As shown in the previous section, Jaguar Land Rover and Mercedes reduced their overall tailpipe emissions by 52 and 34 grams/mile, respectively, since the program started in the 2012 model year.

Table 3-2. Production Volumes Assigned to TLAAS Standards

	Model Year 2012			Model Year 2013			Model Year 2014			Cumulative
Manufacturer	**Cars**	**Trucks**	**All**	**Cars**	**Trucks**	**All**	**Cars**	**Trucks**	**All**	**Total**
Aston Martin				364		364	1,272	0	1,272	1,636
Ferrari	1,510		1,510	1,902		1,902	2,301	0	2,301	5,713
Jaguar Land Rover	12,769	32,706	45,475	9,410	29,464	38,874	12,323	29,130	41,453	125,802
Lotus				170		170	280	0	280	450
McLaren				412		412	279	0	279	691
Mercedes	10,585	20,230	30,815	6	28,437	28,443	7,095	14,740	21,835	81,093
Porsche	16,946	12,927	29,873	22,021	19,461	41,482			0	71,355
Fleet Total	**41,810**	**65,863**	**107,673**	**34,285**	**77,362**	**111,647**	**23,550**	**43,870**	**67,420**	**286,740**

To understand the impact of the TLAAS program on compliance with EPA's GHG program, we determined the grams/mile "benefit" achieved by each manufacturer and accrued for each fleet as a result of using the TLAAS program. For manufacturers placing all their vehicles in a TLAAS fleet the calculation is easy; it is simply the difference between the TLAAS program standard and the Primary Program standard that would have otherwise applied. For manufacturers with a mix of TLAAS and Primary Program vehicles in each fleet, we determined the difference in the total credits (in Megagrams) for each fleet with the use of TLAAS and without the use of TLAAS. This difference was then converted to grams/mile, and the resulting values are shown in Table 3-3. The final row in the table indicates the overall impact from the use of the TLAAS program on the entirety of the model year, not just the set of manufacturers enrolled in the TLAAS program. Thus, the overall net impact on the 2014 fleet of the TLAAS program is 0.3 g/mi. Unlike other credits, the impact of the TLAAS program is not an adjustment to 2-cycle emissions, but rather, an adjustment to the standard. For example, Aston Martin's fleet average standard against which they must demonstrate compliance is 65 grams/mile greater than it would be without use of the TLAAS program.

Table 3-3. Net Impact from Use of the TLAAS Program (g/mi)

	2012 Model Year			2013 Model Year			2014 Model Year		
Manufacturer	**Cars**	**Trucks**	**All**	**Cars**	**Trucks**	**All**	**Cars**	**Trucks**	**All**
Aston Martin				64		64	65		65
Ferrari	69		69	66		66	65		65
Jaguar Land Rover	73	64	66	41	49	47	67	42	46
Lotus				62		62	60		60
McLaren				66		66	64		64
Mercedes	4	22	10	0	27	9	2	13	5
Porsche*	66	84	75	63	82	73			
Fleet Total	**0.3**	**1.2**	**0.7**	**0.2**	**1.2**	**0.6**	**0.2**	**0.6**	**0.3**

*For the purposes of the EPA GHG program, Porsche is aggregated with Volkswagen as of the 2014 model year and is no longer eligible to use the TLAAS standards.

C. Credits Based on Alternative Fuel Vehicles

EPA's GHG program contains several credits and incentives for dedicated and dual fuel alternative fuel vehicles. Dedicated alternative fuel vehicles are vehicles that run exclusively on an alternative fuel (e.g., compressed natural gas, electricity). Dual fuel vehicles can run both on an alternative fuel and on a conventional fuel such as gasoline; the most common is the gasoline-ethanol flexible fuel vehicle, which is a dual fuel vehicle that can run on E85 (85 percent ethanol and 15 percent gasoline), or on conventional gasoline, or on a mixture of both E85 and gasoline in any proportion. Dual fuel vehicles also include vehicles that use compressed natural gas (CNG) and gasoline, or electricity and gasoline. This section separately describes three different and uniquely-treated categories of alternative fuel vehicles: advanced technology vehicles using electricity or hydrogen fuel cells; compressed natural gas vehicles; and gasoline-ethanol flexible fuel vehicles.

1. Advanced Technology Vehicles

EPA's GHG program contains incentives for advanced technology vehicles. For the 2012-2016 model years, the incentive program allows electric vehicles and fuel cell vehicles to use a zero grams/mile compliance value, and plug-in hybrid electric vehicles may use a zero grams/mile value for the portion of operation attributed to the use of grid electricity (i.e., only emissions from the portion of operation attributed to gasoline engine operation are "counted" for the compliance value). Use of the zero grams/mile option is limited to the first 200,000 qualified vehicles produced by a manufacturer in the 2012-2016 model years. Electric vehicles, fuel cell vehicles, and plug-in hybrid electric vehicles that were included in a manufacturer's calculations of early credits also count against the production limits. As noted in Section 2, both General Motors and Mercedes-Benz selected an option in the early credit provisions by which they could choose to set aside their relatively small 2011 model year advanced technology vehicle production for inclusion in a future model year yet to be determined.

All manufacturers of advanced technology vehicles in the 2012-2014 model years are well below the cumulative 200,000 vehicle limit for the 2012-2016 model years, thus all manufacturers remain eligible to continue to use zero grams/mile. If a manufacturer were to reach the cumulative production limit before the 2017 model year, then advanced technology vehicles produced beyond the limit must account for the net "upstream" emissions associated with their vehicles' use of grid electricity relative to vehicles powered by gasoline. Based on vehicle electricity consumption data (which includes vehicle charging losses) and assumptions regarding GHG emissions from today's national average electricity generation and grid transmission losses, a midsize electric vehicle might have upstream GHG emissions of about 180 grams/mile, compared to the upstream GHG emissions of a typical midsize gasoline car of about 60 grams/mile. Thus, the electric vehicle would have a net upstream emissions value of about 120 grams/mile.[29] EPA regulations provide all the information necessary to calculate a unique net upstream value for each electric or plug-in hybrid electric vehicle.[30]

The nature of this incentive is such that it is reflected in the 2-cycle emissions values shown in Section 3.A. For example, the incentive allows Tesla to record zero grams/mile for their fleet (see Table 3-1) in the 2012-2014 model years. Without the incentive, however, the 2014 model year 2-cycle fleet average GHG emissions for Tesla would in fact be about 123 grams/mile.[31] Use of the incentive in Tesla's case in the 2014 model year allows them to generate just over 427,000 Mg of additional GHG credits relative to using the net upstream value of 123 grams/mile. Nissan's passenger car fleet benefits similarly from the ability of the electric Leaf to use zero grams/mile instead of the calculated net upstream value of 70 grams/mile.[32] As a result, the overall impact on Nissan's passenger car fleet in the 2014 model year is an improvement of about one gram/mile, allowing them to generate almost 142,000 Mg of credits more than if the incentive provisions were not in place. The net impact from Nissan and Tesla on the entire 2014 model year fleet of this incentive is thus about 569,000 Mg of credits, or about 0.2 grams/mile. While there are other electric vehicles and plug-in hybrid electric vehicles in the 2014 fleet, as shown in Table 3-4, Nissan and Tesla account for a substantial fraction of the 2014 model year volume of these vehicles. A few thousand of the remaining advanced technology vehicles are electric vehicles, but the majority of the remaining vehicles are plug-in hybrid electric vehicles, which will have a smaller overall impact than electric vehicles because of their use of gasoline in addition to electricity (the other companies with larger volumes of advanced technology vehicles – General Motors and Ford – produce far more plug-in hybrids than dedicated electric vehicles). Because it is unlikely that the total impact of this incentive exceeds 0.5 grams/mile across the 2014 model year fleet, we have not carried out the analysis for all advanced technology vehicles. In the future, however, it may be more important, interesting, and useful to have a complete assessment of the impact of incentives for these vehicles. Table 3-4 shows the 2010-2014 production volumes of advanced technology vehicles that utilized the zero grams/mile incentive.

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[29] Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards, Final Rule, Federal Register 75 (7 May 2010): 25435.
[30] See 40 CFR 600.113-12(n).
[31] Using the calculations prescribed in the regulations, the sales-weighted upstream emissions for Tesla's 2014 passenger cars is 203 grams/mile and the upstream emissions associated with a comparable gasoline vehicle is 80 grams/mile. The difference, or the net upstream emissions of Tesla's 2014 passenger car fleet, is 123 grams/mile.
[32] The upstream GHG emission value for the Nissan Leaf is 141 grams/mile and the upstream emissions associated with a comparable gasoline vehicle is 71 grams/mile. The difference, or the net upstream emissions of the 2014 Leaf, is 70 grams/mile.

Table 3-4. Production Volumes of Advanced Technology Vehicles Using Zero Grams/Mile Incentive, by Model Year

Manufacturer	2010	2011	2012	2013	2014	Total
BMW	-	-	-	-	9,895	9,895
BYD Motors	-	-	11	32	50	93
Coda	-	-	-	37	-	37
Fiat Chrysler	-	-	-	2,353	3,404	5,757
Fisker	-	-	1,415	-	-	1,415
Ford	-	-	653	18,654	18,826	38,133
GM	-	4,370	18,355	27,484	25,847	76,056
Honda	-	-	-	471	1,635	2,106
Mercedes	-	546	25	880	3,610	5,061
Mitsubishi	-	-	1,435	-	219	1,654
Nissan	-	8,495	11,460	26,167	10,339	56,461
Tesla	599	269	2,952	17,813	17,791	39,424
Toyota	-	-	452	829	1,218	2,499
Volkswagen	-	-	-	-	755	755
Total	**599**	**13,680**	**36,758**	**94,720**	**93,589**	**239,346**

2. Compressed Natural Gas Vehicles

The Honda Civic CNG was the only compressed natural gas (CNG) vehicle produced for general purchase by consumers in the 2012-2014 model years, and is a dedicated alternative fuel vehicle. EPA's GHG program contains a temporary incentive for CNG vehicles (for both dedicated and dual fuel vehicles) that applies through the 2015 model year. This incentive, which parallels the incentive offered these vehicles in the CAFE program, allows a CNG vehicle to be represented in the fleet average calculation by a reduced GHG value that is determined by measuring the tailpipe emissions of the vehicle and then multiplying by 0.15. This is effectively the same incentive as under the CAFE program, except that fuel economy is divided, not multiplied, by 0.15.[33] The Civic CNG, which has actual tailpipe GHG emissions of 162 g/mi, is thus "counted" in Honda's fleet average passenger car calculation with a GHG emissions value of 24 g/mi. Although the vehicle-specific incentive is large (a reduction of 138 grams/mile), the net impact on Honda's car fleet is about 0.1 grams/mile due to the low production volume of the Civic CNG (about 750 in model year 2014). This does not affect Honda's overall rounded car fleet average performance value, and likewise has an unnoticeable impact on the overall 2014 model year fleet. If the volume of CNG vehicles (either dual fuel or dedicated vehicles) increases substantially in the future, it will become more important for us to be able to separate out the impact of current and future incentives for these vehicles in a transparent manner.

[33] Use of the 0.15 factor for GHG compliance for dedicated and dual fuel CNG vehicles sunsets after the 2015 model year. Starting with the 2017 model year a production multiplier incentive becomes effective. See the regulations at 40 CFR 86.1866-12(b).

3. Gasoline-Ethanol Flexible-Fuel Vehicles

The impact of ethanol flexible fuel vehicles (FFVs) is easy to determine because we calculate fleet average GHG values both with and without the incentives in order to ensure that no manufacturer exceeds the maximum allowable value of the incentive. Under the GHG program, EPA allows FFV credits intended to correspond to the amounts allowed in the CAFE program under the statutory provisions, but only for the 2012 to 2015 model years. As with the CAFE program, the GHG program bases FFV credits on the assumption that FFVs operate 50% of the time on the alternative fuel and 50% of the time on conventional fuel, resulting in CO_2 emissions that are based on an arithmetic average of alternative fuel and conventional fuel CO_2 emissions. The CO_2 emissions measurement on the alternative fuel is multiplied by a 0.15 factor. The 0.15 factor is used because, under the CAFE program, a gallon of alternative fuel is deemed to contain 0.15 gallons of gasoline fuel. Again, this approach is only applicable for the 2012–2015 model years of the GHG program.

For example, for a flexible-fuel vehicle that emits 330 g/mi CO_2 while operating on E85 and 350 g/mi CO_2 while operating on gasoline, the resulting CO_2 level to be used in the manufacturer's fleet average calculation would be:

$$\mathrm{CO_2} = \frac{[(330 \times 0.15) + 350]}{2} = 199.8 \text{ g/mi}$$

EPA realizes that by temporarily using the CAFE-based approach—including the 0.15 factor—the CO_2 emissions value for the vehicle is calculated to be significantly lower than it actually would be otherwise, even if the vehicle were assumed to operate on the alternative fuel at all times. This represents the short-term "incentive" being provided to FFVs. Under the GHG program, FFV credits are available only through the 2015 model year; starting in model year 2016, GHG compliance values are based on actual emissions performance of the FFV on conventional and alternative fuels, weighted by EPA's assessment of the actual use of these fuels in FFVs.[34] In fact, the standards in the early years of the GHG program were developed with an explicit understanding that some manufacturers would make use of this and other incentive and credit programs to meet the standards.

In the 2014 model year the dual-fuel credit limit in the CAFE program is 1.2 mpg across a manufacturer's separate car and truck fleets (dedicated alternative fuel vehicles and vehicles that use electricity are not subject to this limit on credits). In other words, FFVs may not increase a manufacturer's average fuel economy for its car or truck fleets by more than 1.2 mpg. To parallel the CAFE limitations, the GHG program contains a similar credit limit, but calculated in terms of CO_2 based on each manufacturer's unique fleet average performance. EPA chose this approach because of the non-linearity between mpg and CO_2 emissions. For example, a 1.2 mpg increase from a base of 15 mpg represents a CO_2 decrease of about 44 g/mi, while a 1.2 mpg increase from a base of 30 mpg represents a CO_2 decrease of about 11 g/ mi. Thus, the CO_2 reduction that manufacturers may get from the FFV credits for a given fleet is limited to the CO_2 value

[34] EPA Guidance Letter "E85 Flexible Fuel Vehicle Weighting Factor for Model Year 2016-2018 Vehicles," CD-14-18, November 12, 2014.

comparable to 1.2 mpg and is calculated from a manufacturer's specific fleet average performance value.

Eight manufacturers produced FFVs in the 2014 model year, as shown below in Tables 3-5 and 3-6. Clearly, Fiat Chrysler, Ford, and General Motors produced the overwhelming majority of vehicles capable of operating on E85. Jaguar Land Rover was a new entrant in this field in the 2013 model year, and tripled the number of models capable of operating on E85 in the 2014 model year. Overall, almost 20 percent of model year 2014 vehicles were FFVs. Note that the number of models shown in Table 3-5 is based on EPA's "model type" designation (used for EPA Fuel Economy and Environment Labels), and is not equivalent to "nameplate." Generally speaking, a model type is a unique combination of a nameplate (e.g., Silverado), an engine (e.g., 6 cylinder), a drive system (e.g., 4 wheel drive), and a transmission (e.g., 6-speed automatic). Thus, a single nameplate that is offered with two engines, in both two- and four-wheel drive, and in manual and automatic transmissions, will result in eight different model types. For example, the four Nissan truck models shown in Table 3-5 are made up of two- and four-wheel drive versions of two nameplates, the Titan and the Armada.

Most of these manufacturers focused their FFV production in the truck segment, and truck FFV production made up 75 percent of all FFV production in the 2014 model year. All of these manufacturers increased FFV production in the 2014 model year, bringing over 300,000 more FFVs to market relative to the previous model year, or an increase of about 12 percent. Increases in FFV production from Fiat Chrysler and General Motors accounted for almost 75 percent of the overall increase in FFVs from 2013 to 2014. Volkswagen continued to grow FFV production from very few in the 2012 model year (about 2,000) to more than 65,000 in model year 2014, and Jaguar Land Rover tripled their offerings in model year 2014.

Table 3-5. Number of FFV Models by Manufacturer, 2012-2014 Model Years

Model Year	Category	Fiat Chrysler	Ford	GM	Jaguar Land Rover	Mercedes	Nissan	Toyota	Volkswagen	Total
2012	Car	10	7	19	-	5	-	-	4	45
	Truck	11	23	60	-	1	4	2	-	101
	All	21	30	79	-	6	4	2	4	146
2013	Car	10	6	18	4	7	-	-	10	55
	Truck	13	23	58	-	1	4	2	1	102
	All	23	29	76	4	8	4	2	11	157
2014	Car	10	6	11	6	7	0	0	8	48
	Truck	11	21	44	6	1	4	2	1	90
	All	21	27	55	12	8	4	2	9	138

Table 3-6. Production Volume of FFVs by Manufacturer, 2012-2014 Model Years

Model Year	Category	Fiat Chrysler	Ford	GM	Jaguar Land Rover	Mercedes	Nissan	Toyota	Volkswagen	Total
2012	Car	105,174	174,597	396,264	-	13,493	-	-	2,060	691,588
	Truck	453,399	323,563	511,183	-	8,289	24,154	31,670	-	1,352,258
	All	558,573	498,160	907,447	-	21,782	24,154	31,670	2,060	2,043,846
2013	Car	142,158	209,988	374,354	321	34,493	-	-	30,346	791,660
	Truck	431,359	546,695	637,576	-	22,082	13,650	33,203	20,799	1,705,364
	All	573,517	756,683	1,011,930	321	56,575	13,650	33,203	51,145	2,497,024
2014	Car	76,570	259,189	282,707	2,754	48,597	-	-	39,375	709,192
	Truck	650,617	498,245	801,740	32,013	12,079	14,809	56,516	25,666	2,091,685
	All	727,187	757,434	1,084,447	34,767	60,676	14,809	56,516	65,041	2,800,877

Table 3-7 shows the impact of FFVs on each manufacturer's fleet for the 2012-2014 model years. Fiat Chrysler, Ford, GM, Jaguar Land Rover, Mercedes, and Volkswagen all maximized the FFV credit in both car and truck fleets in the 2014 model year. In other words, these manufacturers produced at least enough FFVs to claim the maximum FFV benefit. The overall impact of FFVs on the fleet as a whole increased slightly from 2013 to 2014 to 9 g/mi.

Table 3-7. Net Credits Accrued from Use of the FFV Incentives (g/mi)

	2012 Model Year			2013 Model Year			2014 Model Year		
Manufacturer	**Cars**	**Trucks**	**All**	**Cars**	**Trucks**	**All**	**Cars**	**Trucks**	**All**
Fiat Chrysler	13*	21*	18	12*	21*	17	12*	19*	17
Ford	9	21*	14	9*	20*	15	9*	20*	14
GM	11*	23*	16	10*	22*	15	10*	19*	14
Jaguar Land Rover	0	0	0	3	0	1	17*	20*	20
Mercedes	11	15	13	12*	12*	12	11*	17*	12
Nissan	0	15	4	0	8	3	0	8	3
Toyota	0	9	4	0	8	4	0	15	6
Fleet Total	**4**	**14**	**8**	**4**	**14**	**8**	**5**	**14**	**9**

Note: Volkswagen is not included in this table due to an ongoing investigation. Based on the original compliance data, Volkswagen's 2014 model year FFV credits are 10 g/mi for cars, 16 g/mi for trucks, and 11 g/mi for the combined fleet.
*Achieved the maximum allowable FFV credit for this fleet.

D. Credits Based on Air Conditioning Systems

The vast majority of new cars and light trucks in the United States are equipped with air conditioning (A/C) systems. There are two mechanisms by which A/C systems contribute to the emissions of greenhouse gases: through leakage of hydrofluorocarbon refrigerants into the atmosphere (sometimes called "direct emissions") and through the consumption of fuel to provide mechanical power to the A/C system (sometimes called “indirect emissions”). The high global warming potential (GWP) of the current predominant automotive refrigerant, HFC-134a, means that leakage of a small amount of refrigerant will have a far greater impact on global warming than emissions of a similar amount of CO_2. The impacts of refrigerant leakage can be reduced significantly by systems that incorporate leak-tight components, or, ultimately, by using a refrigerant with a lower global warming potential. The A/C system also contributes to increased tailpipe CO_2 emissions through the additional work required by the engine to operate the compressor, fans, and blowers. This additional power demand is ultimately met by using additional fuel, which is converted into CO_2 by the engine during combustion and exhausted through the tailpipe. These emissions can be reduced by increasing the overall efficiency of an A/C system, thus reducing the additional load on the engine from A/C operation, which in turn means a reduction in fuel consumption and a commensurate reduction in GHG emissions. Manufacturers may generate and use credits for improved A/C systems in complying with the CO_2 fleet average standards in the 2012 and later model years (or otherwise to be able to bank or trade the credits). These provisions were also used in the 2009-2011 model years to generate early credits, prior to the 2012 model year. Seventeen manufacturers used the A/C credit provisions – either for leakage reductions, efficiency improvements, or both – as part of their compliance demonstration in the 2014 model year.

The A/C provisions are structured as additional and optional credits, unlike the CO_2 standards for which manufacturers must demonstrate compliance using the EPA exhaust emission test procedures. The EPA compliance tests do not measure either A/C refrigerant leakage or the increase in tailpipe CO_2 emissions attributable to the additional engine load of A/C systems. Because it is optional to include A/C-related GHG emission reductions as an input to a manufacturer’s compliance demonstration, the A/C provisions are viewed as an additional program that credits manufacturers for implementing A/C technologies that result in real-world reductions in GHG emissions. A summary of the air conditioning credits reported by the industry for all model years, including the early credit program years, is shown in Table 3-8 (note that because not all manufacturers participated in the early credits program, credit volumes and percentages from 2009-2011 and 2012-2014 are not comparable). Table 3-9 shows the total air conditioning credits (combined leakage and efficiency credits, in Megagrams) reported by each manufacturer in the 2014 model year, and the grams/mile impact across their entire vehicle fleet. Like the TLAAS program and alternative fuel vehicle incentives, EPA’s standards are predicated in part upon manufacturers earning credits for reducing GHG emissions from A/C systems. Table 3-10 shows the benefit of air conditioning credits, translated from Megagrams to grams/mile, for each manufacturer’s fleet for the 2012-2014 model years.

Table 3-8. Reported Air Conditioning Credits by A/C Credit Type and Model Year

Model Year	Leakage Credits		Efficiency Credits		Total (Mg)
	Mg	% of Annual A/C Total	Mg	% of Annual A/C Total	
2009	6,240,447	75%	2,114,612	25%	8,355,059
2010	8,323,530	75%	2,844,066	25%	11,167,596
2011	8,867,747	71%	3,607,832	29%	12,475,579
2012	11,123,194	66%	5,746,946	34%	16,870,140
2013	13,235,125	61%	8,369,102	39%	21,604,227
2014	16,594,532	62%	10,309,246	38%	26,903,778
Total	**64,384,575**	**66%**	**32,991,804**	**34%**	**97,376,379**

Table 3-9. Reported Air Conditioning Credits by Manufacturer, 2014 Model Year

Manufacturer	A/C Leakage Credits (Mg)	A/C Efficiency Credits (Mg)	Total A/C Credits (Mg)	Grams/Mile Equivalent of Total A/C Credits
Aston Martin	783	645	1,428	6
BMW	387,463	311,060	698,523	9
Ferrari	3,408	1,746	5,154	11
Fiat Chrysler	4,300,656	1,839,994	6,140,650	14
Ford	3,259,377	1,115,851	4,375,228	9
GM	3,796,223	2,017,104	5,813,327	10
Honda	626,840	529,963	1,156,803	4
Hyundai	224,140	354,113	578,253	5
Jaguar Land Rover	224,490	81,610	306,100	21
Kia	227,101	333,683	560,784	5
Mercedes	390,814	404,636	795,450	11
Nissan	763,891	753,995	1,517,886	6
Subaru	-	209,944	209,944	2
Tesla	-	19,801	19,801	6
Toyota	1,765,121	1,829,014	3,594,135	8
Volkswagen	578,993	498,716	1,077,709	9
Volvo	45,232	7,371	52,603	8
Fleet Total	**16,594,532**	**10,309,246**	**26,903,778**	**8**

Table 3-10. Net Impact of Air Conditioning Credits (g/mi)

	2012 Model Year			2013 Model Year			2014 Model Year		
Manufacturer	**Cars**	**Trucks**	**All**	**Cars**	**Trucks**	**All**	**Cars**	**Trucks**	**All**
Aston Martin	0	0	0	6	0	6	6	0	6
BMW	7	11	8	8	11	9	8	11	9
Ferrari	10	0	10	10	0	10	11	0	11
Fiat Chrysler	9	10	10	10	11	10	13	14	14
Ford	5	8	6	7	8	8	8	10	9
GM	8	8	8	9	9	9	9	11	10
Honda	2	5	3	3	5	4	3	5	4
Hyundai	4	7	4	5	7	5	5	7	5
Jaguar Land Rover	5	8	7	5	9	8	12	22	21
Kia	5	3	5	5	8	5	5	5	5
Mercedes	9	11	10	9	12	10	10	12	11
Nissan	2	4	3	4	4	4	5	6	6
Subaru	2	2	2	1	2	2	1	2	2
Tesla	6	0	6	6	0	6	6	0	6
Toyota	7	6	7	7	7	7	8	7	8
Volkswagen	6	9	7	6	10	7	8	12	9
Volvo	11	12	11	10	11	10	8	8	8
Fleet Total	**5**	**7**	**6**	**6**	**8**	**7**	**7**	**10**	**8**

1. Air Conditioning Leakage Credits

A manufacturer choosing to generate A/C leakage credits with a specific A/C system is required to calculate a leakage "score" for the A/C system.[35] This score is based on the number, performance, and technology of the components, fittings, seals, and hoses of the A/C system.[36] This score, which is determined in grams per year, is calculated using the procedures specified by the SAE Surface Vehicle Standard J2727. The score is subsequently converted to a grams/mile credit value based on the global warming potential (GWP) of the refrigerant, for consistency with the units of GHG exhaust emissions. The grams/mile value is used to calculate the total tons of credits attributable to an A/C system by accounting for the VMT of the vehicle class (car or truck) and the production volume of the vehicles employing that A/C system.

In the 2012 model year, all leakage credits were based on improvements to the A/C system components, e.g., to O-rings, seals, valves, and fittings. In the 2013 model year, General Motors and Honda introduced vehicles that further reduced the impacts of A/C system leakage by using HFO-1234yf, a relatively new low-GWP refrigerant. These two manufacturers were the first to introduce this refrigerant in U.S. vehicle models (the Cadillac XTS and the Honda Fit EV). HFO-

[35] See 40 CFR 86.1867-12.

[36] The global warming potential (GWP) represents how much a given mass of a chemical contributes to global warming over a given time period compared to the same mass of carbon dioxide. Carbon dioxide's GWP is defined as 1.0.

1234yf has an extremely low GWP of 4, as compared to a GWP of 1430 for HFC-134a, the refrigerant currently used throughout most of the industry. The use of HFO-1234yf expanded considerably in the 2014 model year, from two manufacturers and 42,384 vehicles in the 2013 model year, to five manufacturers and 628,347 vehicles in the 2014 model year (although a large increase, this is still less than 5 percent of the total 2014 model year production). Fiat Chrysler accounted for 86 percent of these vehicles, introducing HFO-1234yf across a number of models, including the 300, Challenger, Charger, Cherokee, Dart, and Ram 1500 trucks. Jaguar Land Rover achieved the greatest penetration within their fleet, using HFO-1234yf in approximately 80 percent of Jaguar Land Rover vehicles produced in the 2014 model year. The net impact on credits is that these manufacturers collectively generated about 1.1 million more Megagrams of air conditioning leakage credits than they would have generated by using HFC-134a. Table 3-11 shows the production volume of models using HFO-1234yf for the 2012-2014 model years, by manufacturer.

Table 3-11. Production of Vehicles Using HFO-1234yf, 2013-2014 Model Years

Manufacturer	2013	2014	Total
Ferrari		394	394
Fiat Chrysler		540,098	540,098
GM	41,913	30,652	72,565
Honda	471	599	1,070
Jaguar Land Rover		56,604	56,604
Total	**42,384**	**628,347**	**670,731**

Fifteen manufacturers reported A/C leakage credits in the 2014 model year, as shown in Table 3-12. These manufacturers reported more than 16.5 million Mg of A/C leakage credits in 2014, accounting for more than 40 percent of the total net credits reported for the model year, and accounting for GHG reductions of about 5 grams/mile across the 2014 vehicle fleet. Table 3-13 shows the leakage credits in grams/mile for the 2012-2014 model years.

Table 3-12. Reported Air Conditioning Leakage Credits by Manufacturer and Fleet, 2014 Model Year (Mg)

Manufacturer	Car	Truck	Total	Grams/mile Equivalent of Total Credits
Aston Martin	783		783	3
BMW	256,260	131,203	387,463	5
Ferrari*	3,408		3,408	8
Fiat Chrysler*	1,113,855	3,186,801	4,300,656	9
Ford	1,412,435	1,846,942	3,259,377	7
GM*	1,918,074	1,878,149	3,796,223	7
Honda*	225,990	400,850	626,840	2
Hyundai	199,151	24,989	224,140	2
Jaguar Land Rover*	15,850	208,640	224,490	15
Kia	208,197	18,904	227,101	2
Mercedes	251,860	138,954	390,814	5
Nissan	414,968	348,923	763,891	3
Toyota	1,045,084	720,037	1,765,121	4
Volkswagen	423,705	155,288	578,993	5
Volvo	20,330	24,902	45,232	7
Fleet Total	**7,509,950**	**9,084,582**	**16,594,532**	**5**

* Some vehicles equipped with systems using HFO-1234yf, a low-GWP refrigerant.

Table 3-13. Air Conditioning Leakage Credits (g/mi)

	2012 Model Year			2013 Model Year			2014 Model Year		
Manufacturer	**Cars**	**Trucks**	**All**	**Cars**	**Trucks**	**All**	**Cars**	**Trucks**	**All**
Aston Martin	-	-	-	3	-	3	3	-	3
BMW	4	7	5	4	7	5	4	7	5
Ferrari*	6	-	6	7	-	7	8	-	8
Fiat Chrysler*	6	8	7	6	8	7	9	10	9
Ford	4	7	6	5	7	7	6	8	7
GM*	6	7	6	6	7	7	6	7	7
Honda*	1	2	2	1	3	2	1	3	2
Hyundai	2	5	2	2	4	2	2	3	2
Jaguar Land Rover*	3	4	4	3	5	4	7	17	15
Kia	2	2	2	2	5	2	2	3	2
Mercedes	4	7	5	4	7	5	5	7	5
Nissan	0	2	1	0	2	1	2	4	3
Toyota	3	3	3	3	3	3	4	4	4
Volkswagen	2	4	2	3	5	3	4	7	5
Volvo	6	8	7	6	7	7	6	7	7
Fleet Total	**3**	**5**	**4**	**3**	**6**	**4**	**4**	**6**	**5**

* Some vehicles equipped with systems using HFO-1234yf, a low-GWP refrigerant.

2. Air Conditioning Efficiency Credits

Manufacturers that make improvements in their air conditioning systems to increase efficiency, thus reducing CO_2 emissions due to air conditioning system operation, may be eligible for air conditioning efficiency credits. Most of the additional load on the engine from air conditioning systems comes from the compressor, which pressurizes the refrigerant and pumps it around the system loop. A significant additional load on the engine may also come from electric or hydraulic fans, which are used to move air across the condenser, and from the electric blower, which is used to move air across the evaporator and into the cabin. Manufacturers have several technological options for improving efficiency, including more efficient compressors, fans, and motors, and system controls that avoid over-chilling the air (and subsequently re-heating it to provide the desired air temperature with an associated loss of efficiency). For vehicles equipped with automatic climate-control systems, real-time adjustment of several aspects of the overall system (such as engaging the full capacity of the cooling system only when it is needed, and maximizing the use of recirculated air) can result in improved efficiency. The regulations provide manufacturers with a “menu” of technologies and associated credit values (in grams/mile of CO_2). The total tons of credits are then based on the total volume of vehicles in a model year using these technologies.

Seventeen manufacturers used the provisions that allow credits based on improvements to the overall efficiency of the A/C system, as shown in Table 3-14. These manufacturers reported a total of more than 10 million Mg of CO_2 A/C efficiency credits in the 2014 model year, making up about 25 percent of the total net credits reported by the industry and accounting for about 3 grams/mile across the 2014 fleet. Table 3-15 shows the efficiency credits in grams/mile for the 2012-2014 model years.

Table 3-14. Reported Air Conditioning Efficiency Credits by Manufacturer and Fleet, 2014 Model Year (Mg)

Manufacturer	Car	Truck	Total	Grams/Mile Equivalent of Total Credits
Aston Martin	645		645	3
BMW	231,480	79,580	311,060	4
Ferrari	1,746		1,746	4
Fiat Chrysler	526,044	1,313,950	1,839,994	4
Ford	518,730	597,121	1,115,851	2
GM	950,133	1,066,971	2,017,104	4
Honda	241,401	288,562	529,963	2
Hyundai	320,839	33,274	354,113	3
Jaguar Land Rover	12,478	69,132	81,610	5
Kia	322,330	11,353	333,683	3
Mercedes	293,107	111,529	404,636	5
Nissan	542,001	211,994	753,995	3
Subaru	30,379	179,565	209,944	2
Tesla	19,801		19,801	6
Toyota	1,284,578	544,436	1,829,014	4
Volkswagen	376,957	121,759	498,716	4
Volvo	4,517	2,854	7,371	1
Fleet Total	**5,677,166**	**4,632,080**	**10,309,246**	**3**

Table 3-15. Air Conditioning Efficiency Credits (g/mi)

Manufacturer	2012 Model Year			2013 Model Year			2014 Model Year		
	Cars	Trucks	All	Cars	Trucks	All	Cars	Trucks	All
Aston Martin	-	-	-	3	-	3	3	-	3
BMW	3	4	3	4	4	4	4	4	4
Ferrari	4	-	4	4	-	4	4	-	4
Fiat Chrysler	3	2	3	3	3	3	4	4	4
Ford	0	0	0	2	1	1	2	2	2
GM	2	1	2	3	2	3	3	4	4
Honda	1	3	2	1	2	2	1	2	2
Hyundai	2	2	2	3	4	3	3	4	3
Jaguar Land Rover	2	4	4	2	4	4	5	6	5
Kia	2	1	2	2	3	3	3	2	3
Mercedes	5	5	5	5	5	5	5	5	5
Nissan	2	2	2	3	2	3	3	2	3
Subaru	2	2	2	1	2	2	1	2	2
Tesla	6	-	6	6	-	6	6	-	6
Toyota	4	2	3	4	3	4	5	3	4
Volkswagen	4	5	4	4	5	4	4	5	4
Volvo	4	4	4	4	4	4	1	1	1
Fleet Total	**2**	**2**	**2**	**3**	**2**	**3**	**3**	**3**	**3**

E. Credits Based on "Off-Cycle" Technology

"Off-cycle" emission reductions can be achieved by employing technologies that result in real-world benefits, but where that benefit is not adequately captured on the test procedures used by manufacturers to demonstrate compliance with emission standards. EPA's light-duty vehicle greenhouse gas program acknowledges these benefits by giving automobile manufacturers three pathways by which a manufacturer may accrue off-cycle CO_2 credits. The first is a predetermined list or "menu" of credit values for specific off-cycle technologies that may be used beginning in model year 2014.[37] This pathway allows manufacturers to use conservative credit values established by EPA for a wide range of off-cycle technologies, with minimal data submittal or testing requirements. This pathway was widely used in the 2014 model year. In cases where additional laboratory testing can demonstrate emission benefits, a second pathway allows manufacturers to use a broader array of emission tests (known as "5-cycle" testing because the methodology uses five different testing procedures) to demonstrate and justify off-cycle CO_2 credits.[38] The additional emission tests allow emission benefits to be demonstrated over some elements of real-world driving not captured by the GHG compliance tests, including high speeds, rapid accelerations, and cold temperatures. Credits determined according to this methodology do not undergo additional public review. General Motors is currently the only

[37] See 40 CFR 86.1869-12(b).
[38] See 40 CFR 86.1869-12(c).

manufacturer to have used this pathway in the 2012-2014 model years. The third and last pathway allows manufacturers to seek EPA approval to use an alternative methodology for determining the off-cycle technology CO_2 credits.[39] This option is only available if the benefit of the technology cannot be adequately demonstrated using the 5-cycle methodology. Manufacturers may also use this option for model years prior to 2014 to demonstrate off-cycle CO_2 reductions for off-cycle technologies that are on the menu, or to demonstrate reductions that exceed those available via use of the menu. Several manufacturers have petitioned for and been granted credits using this pathway, however, no credits have been reported to date from this pathway, thus they will be included in a subsequent report.[40]

Table 3-16 shows the total off-cycle technology credits reported by manufacturers in the 2014 model year and the grams/mile impact on their respective fleets. Clearly the technologies involved are currently implemented to varying degrees across manufacturers, accounting for anywhere from zero grams/mile (the manufacturers not shown in Table 3-16) to 6.1 grams/mile for Fiat Chrysler. Off-cycle credits from these 12 manufacturers accounted for a benefit of 2.3 grams/mile across the entire 2014 model year fleet.

Table 3-17 shows the off-cycle credits in grams/mile for the 2012-2014 model years. Although GM did generate off-cycle credits in the 2012 and 2013 model years, the grams/mile equivalent of those credits rounds to 0.0, as shown, as is also the case for Subaru in model year 2014.

Table 3-16. Reported Off-Cycle Technology Credits by Manufacturer and Fleet, 2014 Model Year (Mg)

Manufacturer	Car	Truck	Total	Grams/Mile Equivalent of Total Credits
BMW	183,103	113,537	296,640	3.9
Fiat Chrysler	416,894	2,361,453	2,778,347	6.1
Ford	501,470	769,099	1,270,569	2.6
GM	228,888	457,702	686,590	1.2
Honda	164,811	239,134	403,945	1.3
Hyundai	59,075	26,111	85,186	0.8
Jaguar Land Rover	5,315	69,170	74,485	5.0
Kia	88,313	3,428	91,741	0.9
Mercedes	143,849	24,232	168,081	2.2
Nissan	263,734	214,182	477,916	1.8
Subaru	-	1,045	1,045	0.0
Toyota	578,927	567,623	1,146,550	2.5
Fleet Total	**2,634,379**	**4,846,716**	**7,481,095**	**2.3**

[39] See 40 CFR 86.1869-12(d).
[40] EPA maintains a web page on which we publish the manufacturers' applications for these credits, the relevant Federal Register notices, and the EPA decision documents. See http://www3.epa.gov/otaq/regs/ld-hwy/greenhouse/ld-ghg.htm.

Table 3-17. Off-Cycle Technology Credits (g/mi)

	2012 Model Year			2013 Model Year			2014 Model Year		
Manufacturer	**Cars**	**Trucks**	**All**	**Cars**	**Trucks**	**All**	**Cars**	**Trucks**	**All**
BMW	-	-	-	-	-	-	3.2	6.1	3.9
Fiat Chrysler	-	-	-	-	-	-	3.3	7.2	6.1
Ford	-	-	-	-	-	-	2.0	3.2	2.6
GM	0.0	0.0	0.0	0.0	0.0	0.0	0.8	1.7	1.2
Honda	-	-	-	-	-	-	1.0	1.8	1.3
Hyundai	-	-	-	-	-	-	0.6	3.0	0.8
Jaguar Land Rover	-	-	-	-	-	-	2.2	5.5	5.0
Kia	-	-	-	-	-	-	0.9	0.5	0.9
Mercedes	-	-	-	-	-	-	2.6	1.2	2.2
Nissan	-	-	-	-	-	-	1.4	2.4	1.8
Subaru	-	-	-	-	-	-	-	0.0	0.0
Toyota	-	-	-	-	-	-	2.1	3.3	2.5
Fleet Total	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**1.5**	**3.4**	**2.3**

1. Off-Cycle Credits Based on the Menu

Starting with 2014 models, manufacturers have a new option for generating GHG credits, in the form of "default" credit values specified in the regulations (a "menu" of technologies with credit values, or the calculation method for such values, clearly defined) for certain off-cycle technologies installed on vehicles. More than 99 percent of 2014 off-cycle credits were generated via this pathway, as it was the only pathway used by all manufacturers except GM. Thus, except for GM, the values in the tables below will be identical to the tables above that summarize all 2014 off-cycle credits. Although this will change in future years as manufacturers submit data for credits from the other pathways, we expect that the menu credit pathway may always be the largest generator of off-cycle credits. The impact of credits from this pathway on a manufacturer's fleet is capped at 10 grams/mile, meaning that any single vehicle might accumulate more than 10 grams/mile, but the cumulative effect on a single manufacturer may not exceed a credit, or reduction, of more than 10 grams/mile.

Table 3-18 shows the total off-cycle credits based on the menu pathway reported by manufacturers in the 2014 model year and the grams/mile impact on their respective fleets.

Table 3-18. Reported Off-Cycle Technology Credits from the Menu, by Manufacturer and Fleet, 2014 Model Year (Mg)

Manufacturer	Car	Truck	Total	Grams/Mile Equivalent of Total Credits
BMW	183,103	113,537	296,640	3.9
Fiat Chrysler	416,894	2,361,453	2,778,347	6.1
Ford	501,470	769,099	1,270,569	2.6
GM	182,383	457,702	640,085	1.1
Honda	164,811	239,134	403,945	1.3
Hyundai	59,075	26,111	85,186	0.8
Jaguar Land Rover	5,315	69,170	74,485	5.0
Kia	88,313	3,428	91,741	0.9
Mercedes	143,849	24,232	168,081	2.2
Nissan	263,734	214,182	477,916	1.8
Subaru		1,045	1,045	0.0
Toyota	578,927	567,623	1,146,550	2.5
Fleet Total	**2,587,874**	**4,846,716**	**7,434,590**	**2.3**

Tables 3-19 and 3-20 provide details regarding the specific off-cycle technologies, including how many credits were reported for each technology, and the implementation rate of each off-cycle technology by manufacturers. Several of these technologies are “thermal control technologies” in that they reduce the demand on the air conditioning system by venting hot air, by moving heat away from passengers, or by reducing external heating from the sun. Due to expected synergistic effects of the thermal technologies, the credits from the group of thermal control technologies are capped at 3.0 grams/mile for cars and 4.3 grams/mile for trucks. The per-vehicle grams/mile credit varies between cars and trucks; for example, the credit available for active seat ventilation is 1 gram/mile for cars and 1.3 grams/mile for trucks. The regulations clearly define each technology and any requirements that apply for the technology to generate credits. The definitions may be summarized as follows:

- *Active aerodynamics* – These technologies are automatically activated to improve the aerodynamics of a vehicle under certain conditions. These include grill shutters, which allow air to flow around the vehicle more efficiently, and suspension systems that improve air flow at higher speeds by reducing the height of the vehicle. Credits are based on the measured improvement in the coefficient of drag, a test metric that reflects the efficiency of airflow around a vehicle.
- *Thermal control technologies* – These systems reduce the air temperature of the vehicle interior, lowering GHG tailpipe emissions by reducing the fuel demand on the air conditioning system. Thermal control technologies are subject to a per-vehicle cap on credits of 3.0 grams/mile for cars and 4.3 grams/mile for trucks.
    - *Active and passive cabin ventilation* –Active systems use mechanical means to vent the interior, while passive systems rely on convective air flow. Credits range from 1.7 to 2.8 grams/mile.

- *Active seat ventilation* - These systems move air through the seating surface, transferring heat away from the vehicle occupants. Credits are 1.0 gram/mile for cars and 1.3 grams/mile for trucks.
  - *Glass or glazing* – Credits are available for glass or glazing technologies that reduce the total solar transmittance through the glass, thus reducing the heat from the sun that reaches the occupants. The credits are calculated based on the measured solar transmittance through the glass and on the total area of glass on the vehicle.
  - *Solar reflective surface coating* – Credits are available for solar reflective surface coating (e.g., paint) that reflects at least 65 percent of the infrared solar energy. Credits are 0.4 grams/mile for cars and 0.5 grams/mile for trucks.
- *Active engine and transmission warmup* – These systems use heat from the vehicle that would typically be wasted (exhaust heat, for example) to warm up key elements of the engine, allowing a faster transition to warm operation. A warmed up engine and/or transmission consumes less fuel and emits less tailpipe CO_2.
  - *Active engine warmup* – Uses waste heat from the engine to warm up the engine. Credits are 1.5 grams/mile for cars and 3.2 grams/mile for trucks.
  - *Active transmission warmup* – Uses waste heat from the engine to warm up the transmission. Credits are 1.5 grams/mile for cars and 3.2 grams/mile for trucks.
- *Engine idle stop-start* – These systems allow the engine to turn off when the vehicle is at a stop (e.g., at a stoplight), automatically restarting the engine when the driver releases the brake and/or applies pressure to the accelerator. If equipped with a switch to disable the system, EPA must determine that the predominant operating mode of the system is the “on” setting (defaulting to “on” every time the key is turned on is one basis for such a determination). Thus some vehicles with these systems, such as those from BMW, are not eligible for credits. Credits range from 1.5 to 4.4 grams/mile, and depend on whether the system is equipped with an additional technology that allows heat, when demanded, to continue to be circulated to the vehicle occupants when the engine is off during a stop-start event.
- *High efficiency exterior lights* – These lights reduce the total electric demand, and thus the fuel consumption and GHG emissions, of the lighting system in comparison to conventional lighting technologies. Credits are based on the specific lighting locations, ranging from 0.06 grams/mile for turn signals and parking lights to 0.38 grams/mile for low beams. The total of all lighting credits may not exceed 1.0 grams/mile.
- *Solar panels* – Vehicles that use batteries for propulsion, such as electric, plug-in hybrid electric, and hybrid vehicles may receive credits for solar panels that are used to charge the battery directly or to provide power directly to essential vehicle systems (e.g., heating and cooling systems). Credits are based on the rated power of the solar panels.

Table 3-19. Off-Cycle Technology Credits from the Menu by Technology, 2014 Model Year (Mg)*

Off-Cycle Technology	Car	Truck	Total	Grams/Mile Equivalent of Total
Active Aerodynamics				
Grill shutters	164,456	60,336	224,792	0.1
Ride height adjustment	36	9128	9164	0.0
Subtotal:	164,492	69,464	233,956	0.1
Thermal Control Technologies				
Passive cabin ventilation	246,308	721,833	968,141	0.3
Active cabin ventilation	98,289	51,819	150,108	0.0
Active seat ventilation	112,383	209,826	322,209	0.1
Glass or glazing	418,977	1,798,350	2,217,327	0.7
Solar reflective surface coating	60,597	57,310	117,907	0.0
Subtotal:	936,554	2,839,138	3,775,692	1.2
Engine & Transmission Warmup				
Active engine warmup	314,339	811,804	1,126,143	0.3
Active transmission warmup	673,553	939,597	1,613,150	0.5
Subtotal:	987,892	1,751,401	2,739,293	0.9
Other				
Engine idle stop-start	291,797	60,982	352,779	0.1
High efficiency exterior lights	207,265	126,938	334,203	0.1
Solar panel(s)	41	-	41	0.0
Subtotal:	499,103	187,920	687,023	0.2
Total	**2,588,041**	**4,847,923**	**7,435,964**	**2.3**

*Credits are not always reported by manufacturers in a format that shows the total credits for each technology as we show here. For the purposes of this report we have used the data from manufacturers to calculate the credits in this table.

Table 3-20 shows the percent of each manufacturers' production volume using each of the "menu" technologies, i.e., the penetration rate of a given technology within a manufacturer's fleet. The totals of the manufacturer rows are not provided, as they would sum to more than 100% and are not meaningful values, reflecting only that some vehicles are equipped with multiple off-cycle technologies. The data is not currently collected in a format across all manufacturers that allows a determination of how many vehicles have at least one off-cycle technology or how many technologies are on a given vehicle, thus the total would only indicate how many individual technologies were used to generate credits. However, the implementation rates are still useful and reveal some interesting things. For example, there was significant penetration of glass or glazing technology across these manufacturers, with more than half of them reporting installing this technology on more than 50 percent of their vehicles, and three manufacturers approaching a 100 percent implementation rate (Fiat Chrysler, Ford, and Jaguar Land Rover). High efficiency lighting is another technology with high penetration across a number of manufacturers, with six manufacturers reporting implementation on at least half of their fleet, and Jaguar Land Rover and BMW at or near 100 percent. Traditionally the domain of hybrid gas-electric vehicles, engine idle stop-start is making inroads across conventional vehicles, to a significant degree with some manufacturers. Jaguar Land Rover and Mercedes had the highest proportion of vehicles equipped with engine idle stop-start, with 93 and 65 percent, respectively. The most "popular" technologies across the manufacturers were high efficiency lights and active seat ventilation, both of which were employed by 11 of 12 manufacturers, followed by glass or glazing, used by 9 manufacturers. Although active seat ventilation was used by many manufacturers, it remains a technology with limited offering, appearing on only about ten percent of the 2014 model year fleet, with Jaguar Land Rover appearing the outlier with implementation on more than 60 percent of their vehicles (this is consistent with this technology being largely limited to luxury brands or models). The most widely used technologies across the fleet were glass or glazing, appearing on 7.8 million vehicles (more than half of the 2014 fleet), and high efficiency lighting, which was installed on 6.7 million vehicles, or about 40 percent of the fleet. Toyota and Fiat Chrysler were the leaders in terms of the number of technologies used to generate off-cycle credits, each gaining GHG reductions from nine unique technologies implemented at varying rates across their fleets. Fiat Chrysler used every menu technology except ride height adjustment, active cabin ventilation, and solar panels, where Toyota used all but grill shutters, active cabin ventilation, and solar panels.

Table 3-21 shows the grams/mile benefit that each manufacturer accrued from each off-cycle technology. Like the preceding table, this demonstrates the mix of technologies being used across the manufacturers and the extent to which each technology benefits each manufacturer's fleet. Fiat Chrysler, Jaguar Land Rover, and BMW can be singled out as the manufacturers showing the greatest benefits from off-cycle technologies, from 3.9 to 6.4 grams/mile, while most of the remaining manufacturers achieved between 1 and 2.5 grams/mile. A closer look shows different strategies across these manufacturers of varying sizes and product lines. Fiat Chrysler achieved the manufacturer-leading benefit of 6.1 grams/mile largely through use of passive cabin ventilation, glass or glazing, and active engine warmup systems, with the remainder coming from active transmission warmup systems, high-efficiency lights, and active seat ventilation. Their implementation rate of passive cabin ventilation of almost 100 percent is notable, as the next highest implementation rate of such systems is Toyota, with an 11.4 percent use rate of passive cabin ventilation. Fiat Chrysler's penetration rate of glass/glazing and active engine warmup systems, although high, is in line with that of other manufacturers. BMW was the only manufacturer using active cabin ventilation, with an 85 percent implementation rate and accounting for about half of their 3.9 grams/mile total off-cycle credits. BMW was also the leader in penetration of active engine warmup systems, which accounted for 1.6 grams/mile, and runner-up in the use of high-efficiency lighting, bringing them another 0.3 grams/mile. Jaguar Land Rover, which, as noted earlier, has made very large GHG reductions across their fleet since the start of the program, gained half of their 5.0 grams/mile of off-cycle credits through adoption of stop-start systems across the vast majority of their product line. No other manufacturer has approached this penetration rate except Mercedes, with 65 percent of their vehicles using stop-start systems. Most of BMW's remaining 2.5 grams/mile came from active seat ventilation and glass/glazing, where in both cases Jaguar Land Rover is the industry leader in implementation.

Table 3-20. Percent of 2014 Model Year Vehicle Production Volume with Credits from the Menu, by Manufacturer & Technology (%)

Manufacturer	Active Aerodynamics		Thermal Control Technologies					Engine & Transmission Warmup		Other		
	Grill shutters	Ride height adjustment	Passive cabin ventilation	Active cabin ventilation	Active seat ventilation	Glass or glazing	Solar reflective surface coating	Active engine warmup	Active transmission warmup	Engine idle stop-start	High efficiency exterior lights	Solar panel(s)
BMW	0.0	0.0	0.0	85.1	2.5	2.9	0.0	78.5	0.0	0.0	98.1	0.0
Fiat Chrysler	16.4	3.6	99.3	0.0	1.8	99.3	1.3	58.0	11.7	0.0	73.3	0.0
Ford	38.4	0.0	0.0	0.0	12.8	97.2	12.5	9.6	16.2	3.4	52.9	0.0
GM	6.7	0.0	0.0	0.0	13.3	52.3	15.6	0.0	0.0	6.7	28.2	0.0
Honda	0.0	0.0	0.0	0.0	0.9	0.0	0.0	0.0	58.5	0.0	28.2	0.0
Hyundai	2.1	0.0	0.0	0.0	12.1	84.4	0.0	0.0	16.7	0.0	36.2	0.0
Jaguar Land Rover	0.0	0.0	0.0	0.0	62.6	98.1	0.0	0.0	0.0	93.0	100.0	0.0
Kia	1.8	0.0	0.0	0.0	15.8	76.1	0.0	0.0	22.7	0.6	59.5	0.0
Mercedes	0.0	0.0	0.0	0.0	8.7	3.9	0.0	0.0	0.0	65.3	35.7	0.0
Nissan	4.6	0.0	0.0	0.0	4.9	0.0	0.0	19.5	55.7	0.9	50.1	0.2
Subaru	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Toyota	0.0	0.2	11.4	0.0	13.5	52.9	25.5	9.2	53.8	12.5	44.5	0.0
Fleet Total	**9.8**	**0.0**	**15.0**	**2.1**	**9.6**	**50.7**	**8.7**	**14.2**	**23.2**	**5.5**	**43.0**	**0.0**

Table 3-21. Off-Cycle Technology Credits from the Menu, by Manufacturer and Technology (g/mi)

	Active Aerodynamics		Thermal Control Technologies					Engine & Transmission Warmup		Other			
Manufacturer	**Grill shutters**	**Ride height adjustment**	**Passive cabin ventilation**	**Active cabin ventilation**	**Active seat ventilation**	**Glass or glazing**	**Solar reflective surface coating**	**Active engine warmup**	**Active transmission warmup**	**Engine idle stop-start**	**High efficiency exterior lights**	**Solar panel(s)**	**Total**
BMW	-	-	-	2.0	0.0	0.0	-	1.6	-	-	0.3	-	**3.9**
Fiat Chrysler	0.1	0.0	2.0	-	0.0	1.8	0.0	1.7	0.4	0.0	0.2	-	**6.1**
Ford	0.3	-	-	-	0.2	1.3	0.1	0.2	0.4	0.1	0.1	-	**2.6**
GM	0.0	-	-	-	0.2	0.7	0.1	-	-	0.1	0.1	-	**1.2**
Honda	-	-	-	-	0.0	-	-	-	1.3	-	0.1	-	**1.3**
Hyundai	0.0	-	-	-	0.1	0.3	-	-	0.3	-	0.0	-	**0.8**
Jaguar Land Rover	-	-	-	-	0.8	1.2	-	-	-	2.5	0.5	-	**5.0**
Kia	0.0	-	-	-	0.2	0.3	-	-	0.3	0.0	0.1	-	**0.9**
Mercedes	-	-	-	-	0.1	0.1	-	-	-	1.7	0.4	-	**2.2**
Nissan	0.0	-	-	-	0.1	-	-	0.3	1.2	0.0	0.2	0.0	**1.8**
Subaru	0.0	-	-	-	-	-	-	-	-	-	-	-	**0.0**
Toyota	-	0.0	0.2	-	0.2	0.6	0.1	0.1	1.1	0.2	0.1	-	**2.5**
Fleet Total	**0.1**	**0.0**	**0.3**	**0.0**	**0.1**	**0.7**	**0.0**	**0.3**	**0.5**	**0.1**	**0.1**	**0.0**	**2.3**

Note that "0.0" indicates that the manufacturer did implement that technology, but that the overall penetration rate was not high enough to round to 0.1 grams/mile, whereas a dash indicates no use of a given technology by a manufacturer.

2. Off-Cycle Technology Credits Based on 5-Cycle Testing

As was the case in the 2012 and 2013 model years, GM is the only manufacturer to have requested and been granted off-cycle credits based on 5-cycle testing. These credits are for an off-cycle technology used on certain GM gasoline-electric hybrid vehicles. The technology is an auxiliary electric pump, which keeps engine coolant circulating in cold weather while the vehicle is stopped and the engine is off. GM received off-cycle credits in the early credits program for hybrid full size pick-up trucks that were equipped with this technology. In the 2012 model year, the technology was expanded to include two Buick hybrid passenger car models. In the 2013 model year the technology was applied to GM's full-size hybrid trucks as well as the Buick LaCrosse, Buick Regal, and Chevrolet Malibu models equipped with GM's "eAssist" technology (about 2,000 trucks and 45,000 cars). The 2014 model year GM vehicles receiving this credit were the eAssist-equipped Buick LaCrosse, Buick Regal, Chevrolet Malibu, and Chevrolet Impala, totaling almost 160,000 vehicles. These vehicles feature engine stop-start capability for improved fuel economy, and as a result the engine can frequently be turned off when the vehicle is stopped, such as at a traffic light, resulting in real-world fuel savings. However, during cold weather, a hybrid vehicle without the auxiliary heater pump would need to keep the engine idling during the stop periods solely to maintain coolant flow to the heater to maintain a comfortable temperature inside the vehicle. This would reduce the fuel economy benefits of the stop-start feature during cold weather, which is an "off-cycle" temperature condition not captured by the greenhouse gas compliance test methods. The off-cycle credits reported by GM in the 2009-2013 model years are shown in Table 3-22. The calculated grams/mile benefit rounds to zero because of the low volume of these credits, thus the table does not display these credits in equivalent grams/mile.

Table 3-22. Reported Off-Cycle Credits Based on 5-Cycle Testing (Mg)

Model Year	Car	Truck	Total
2009	-	3,329	3,329
2010	-	965	965
2011	-	1,338	1,338
2012	4,984	838	5,822
2013	13,330	819	14,149
2014	46,505	-	46,505
Total	**64,819**	**7,289**	**72,108**

3. Off-Cycle Technology Credits Based on an Alternative Methodology

This third pathway for off-cycle technology credits allows manufacturers to seek EPA approval to use an alternative methodology for determining the off-cycle technology CO_2 credits.[41] This option is only available if the benefit of the technology cannot be adequately demonstrated using the 5-cycle methodology. Manufacturers may also use this option for model years prior to 2014

[41] See 40 CFR 86.1869-12(d).

to demonstrate off-cycle CO_2 reductions for off-cycle technologies that are on the menu, or to demonstrate reductions that exceed those available via use of the menu. The regulations require that EPA seek public comment on and publish each manufacturer's application for credits sought using this pathway. Several manufacturers have petitioned for and been granted credits using this pathway.[42] However, no credits in this category have yet been reported to EPA, and thus they are not included in this report. EPA anticipates that these credits will be reported in the 2015 model year GHG Performance Report.

In the fall of 2013, Mercedes requested off-cycle credits for the following off-cycle technologies in use or planned for implementation in the 2012-2016 model years: stop-start systems, high-efficiency lighting, infrared glass glazing, and active seat ventilation. EPA approved methodologies for Mercedes to determine these off-cycle credits in September of 2014.[43] Subsequently, Fiat Chrysler, Ford, and GM requested off-cycle credits under this pathway. Fiat Chrysler and Ford submitted applications for off-cycle credits from high efficiency exterior lighting, solar reflective glass/glazing, solar reflective paint, and active seat ventilation. Ford's application also demonstrated off-cycle benefits from active aerodynamic improvements (grill shutters), active transmission warm-up, active engine warm-up technologies, and engine idle stop-start. GM's application described the real-world benefits of an air conditioning compressor with variable crankcase suction valve technology. EPA approved the credits for Fiat Chrysler, Ford, and GM in September of 2015.[44]

F. Deficits Based on Methane and Nitrous Oxide Standards

EPA finalized emission standards for methane (CH_4) and nitrous oxide (N_2O) emissions as part of the rule setting the 2012-2016 model year GHG standards. The standards that were set in that rulemaking were 0.010 grams/mile for N_2O and 0.030 grams/mile for CH_4. These standards were established to cap emissions of GHGs, given that current levels of CH_4 and N_2O are generally significantly below these established standards. These capping standards were intended to prevent future increases in emissions of these GHGs, and were generally not expected to result in the application of new technologies or significant costs for manufacturers using current designs.

There are three different ways for a manufacturer to demonstrate compliance with these standards. First, and used by most manufacturers, manufacturers may demonstrate compliance with these standards with test data as they do for all other non-GHG emission standards. Because there are no credits or deficits involved with this approach, and there are no consequences with respect to the CO_2 fleet average calculation, the manufacturers are not required to submit this data as part of their GHG reporting and hence this GHG compliance report does not include information from manufacturers using this option. Second, EPA also allows an alternative CO_2-

[42] EPA maintains a web page on which we publish the manufacturers' applications for these credits, the relevant Federal Register notices, and the EPA decision documents. See http://www3.epa.gov/otaq/regs/ld-hwy/greenhouse/ld-ghg.htm.

[43] "EPA Decision Document: Mercedes-Benz Off-cycle Credits for MYs 2012-2016," U.S. EPA-420-R-14-025, Office of Transportation and Air Quality, September 2014. See http://www.epa.gov/otaq/regs/ld-hwy/greenhouse/documents/420r14025.pdf.

[44] "EPA Decision Document: Off-cycle Credits for Fiat Chrysler Automobiles, Ford Motor Company, and General Motors Corporation," U.S. EPA-420-R-15-014, Office of Transportation and Air Quality, September 2015. See http://www3.epa.gov/otaq/regs/ld-hwy/greenhouse/documents/420r15014.pdf.

equivalent standard option, which manufacturers may choose in lieu of complying with the cap standards. This CO_2-equivalent standard option allows manufacturers to include CH_4 and N_2O, on a CO_2-equivalent basis, in their CO_2 emissions fleet average compliance level. This is done without adjusting the fleet average CO_2 standard to account for the addition of CH_4 and N_2O emissions. Manufacturers that choose this option are required to include the CH_4 and N_2O emissions of all their vehicles for the purpose of calculating their fleet average. In other words, the value of CREE (the carbon-related exhaust emissions, as described earlier) for these manufacturers will include CO_2, hydrocarbons, and carbon monoxide, as well as CH_4 and N_2O emissions (which are adjusted to account for their higher global warming potential than CO_2), for all their vehicles. Analyses of emissions data have shown that use of this option may add approximately 3 grams/mile to a manufacturer's fleet average. Four manufacturers chose to use this approach in the 2014 model year: Lotus, Nissan, Mazda, and Subaru.

The third option for complying with the CH_4 and N_2O standards was initially limited to the 2012-2014 model years, but was subsequently expanded to include all model years of the program. Under this approach, manufacturers can essentially define an alternative, less stringent CH_4 and/or N_2O standard for any vehicle that may have difficulty meeting the specific standards. This alternative standard is treated as any other emission standard in that it must be met for the full useful life of the vehicle. This method provides some additional flexibility relative to the other two options in that (1) a manufacturer can target specific vehicles for alternative standards without incurring a fleet-wide impact, and (2) CH_4 and N_2O are delinked, in that a manufacturer can meet the default regulatory standard for one and select an alternative standard for the other. However, the key aspect of this approach is that manufacturers that use it must calculate a deficit (in Megagrams) based on the less stringent standards and on the production volumes of the vehicles to which those standards apply. Five manufacturers made use of the flexibility offered by this approach in the 2014 model year, as shown in Table 3-23. Like any other deficit, these deficits must ultimately be offset by CO_2 credits. While these deficits could be carried forward to the next three model years like other deficits, all of the manufacturers using this approach were able to cover these incremental deficits with credits, either carried forward from 2009-2013 or generated in 2014.

Table 3-23. Reported CH_4 and N_2O Deficits by Manufacturer and Fleet, 2014 Model Year (Mg)

	Car		Truck			Grams/Mile
Manufacturer	**CH_4**	**N_2O**	**CH_4**	**N_2O**	**Total**	**Equivalent of Total**
BMW	4,677	37,167	1,365	10,847	54,056	0.7
Fiat Chrysler	755	-	46,268	-	47,023	0.1
Ford	14,512	5,272	44,119	28,579	92,482	0.2
GM	14,061	7,384	43,744	-	65,189	0.1
Honda		224,693			224,693	0.7
Fleet Total	**78,580**	**394,897**	**136,418**	**57,925**	**667,820**	**0.2**

Note: Volkswagen is not included in this table due to an ongoing investigation. Based on the original compliance data, Volkswagen had car deficits of 44,575 and 120,381 Mg for CH4 and N2O, respectively, and truck deficits of 922 and 18,499 Mg for CH4 and N2O, respectively, for a total of 184,377 Mg and a fleet impact of 1.6 g/mi.

Tables 3-24 and 3-25 show the grams/mile equivalent CH_4 and N_2O deficits for the 2012-2014 model years. As in all of the tables in this document, the final Fleet Total row indicates the impact across the entire fleet, including manufacturers and vehicles that did not participate in the alternative CH_4 and/or N_2O standards.

Table 3-24. CH_4 Deficits (g/mi)

	2012 Model Year			2013 Model Year			2014 Model Year		
Manufacturer	Cars	Trucks	All	Cars	Trucks	All	Cars	Trucks	All
BMW	0.0	0.3	0.1	0.0	0.1	0.0	0.1	0.1	0.1
Fiat Chrysler	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.1
Ford	0.1	0.2	0.1	0.1	0.2	0.1	0.1	0.2	0.1
GM	0.1	0.4	0.2	0.1	0.4	0.2	0.0	0.2	0.1
Fleet Total	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.0**	**0.1**	**0.1**

Note: Volkswagen is not included in this table due to an ongoing investigation. Based on the original compliance data, Volkswagen has a CH_4 deficit of 0.5 g/mi for cars, 0.0 g/mi for trucks, and 0.4 g/mi for their total fleet.

Table 3-25. N_2O Deficits (g/mi)

	2012 Model Year			2013 Model Year			2014 Model Year		
Manufacturer	Cars	Trucks	All	Cars	Trucks	All	Cars	Trucks	All
BMW	0.0	1.1	0.3	0.0	0.2	0.1	0.6	0.6	0.6
Ford	0.0	0.9	0.4	0.0	0.9	0.5	0.0	0.1	0.1
GM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Honda	0.0	0.0	0.0	1.1	0.0	0.7	1.3	0.0	0.7
Fleet Total	**0.1**	**0.2**	**0.1**	**0.2**	**0.2**	**0.2**	**0.2**	**0.0**	**0.1**

Note: Volkswagen is not included in this table due to an ongoing investigation. Based on the original compliance data, Volkswagen has an N_2O deficit of 1.3 g/mi for cars, 0.8 g/mi for trucks, and 1.2 g/mi for their total fleet.

G. 2014 Model Year Compliance Values

As described at the outset of this section, there are a number of "building blocks" that are assembled to describe a manufacturer's performance in a given model year. These elements cumulatively make up a manufacturer's "compliance value," i.e., the performance value specific to a given model year and fleet that is compared to an emissions standard (or target) to determine whether a fleet generates a net credit or deficit balance in that model year. Table 3-26 summarizes all of these building blocks (described in previous sections) for the 2014 model year fleet for each manufacturer. The values in Table 3-26 are calculated for each manufacturer's combined car and truck fleet by weighting car and truck values according to the relative production volumes and VMT of cars and trucks.[45] The final row shows values for the total 2014

[45] The compliance and target values do not represent official regulatory values. Regulatory target values are determined separately for car and truck fleets. The compliance value is not a regulatory value, but rather is a calculated value based on each manufacturers' unique car and truck sales weighting for a given model year, and is shown as a way of portraying the cumulative impact of a manufacturer's tailpipe performance and any optional credits used by a manufacturer.

fleet. Note that the compliance value for each manufacturer can be derived from the values in the table by applying the credits and deficits to the 2-cycle tailpipe value. For example, Ford's 2-cycle tailpipe emissions of 315 grams/mile is reduced by applying FFV, A/C, and off-cycle credits totaling 26 grams/mile, yielding a final compliance value of 289 grams/mile (any apparent mathematical differences are the result of rounding). Tables 3-27 and 3-28 show the same information for car and truck fleets, respectively.[46] The resulting compliance values can then be compared to the target values for each fleet to determine whether a manufacturer will report credits or deficits in the 2014 model year. Again, these values are not regulatory values, but are calculated from the Megagrams of credits reported by the manufacturers to EPA.

[46] Versions of Tables 3-19, 3-20, and 3-21 for the 2012 and 2013 model years are shown in Appendix C.

Table 3-26. 2014 Compliance Values - Combined Passenger Car & Light Truck Fleet (g/mi)

Manufacturer	2-Cycle Tailpipe	Credits (g/mi) FFV	A/C	Off-Cycle	CH_4 & N_2O Deficit	Compliance Value
Aston Martin	454	0	6	0	0	448
BMW	270	0	9	4	1	257
BYD Motors	0	0	0	0	0	0
Ferrari	484	0	11	0	0	473
Fiat Chrysler	346	17	14	6	0	309
Ford	315	14	9	3	0	289
GM	314	14	10	1	0	288
Honda	259	0	4	1	0	254
Hyundai	253	0	5	1	0	247
Jaguar Land Rover	374	20	21	5	0	329
Kia	269	0	5	1	0	263
Lotus	338	0	0	0	0	338
Mazda	240	0	0	0	0	240
McLaren	372	0	0	0	0	372
Mercedes	309	12	11	2	0	284
Mitsubishi	236	0	0	0	0	236
Nissan	263	3	6	2	0	253
Subaru	253	0	2	0	0	251
Tesla[47]	0	0	6	0	0	-6
Toyota	274	6	8	3	0	258
Volvo	319	0	8	0	0	311
Fleet Total	**294**	**9**	**8**	**2**	**0**	**274**

Note: Volkswagen is not included in this table due to an ongoing investigation. Based on the original compliance data, Volkswagen has a 2-cycle tailpipe value of 280 g/mi, an FFV credit of 11 g/mi, an A/C credit of 9 g/mi, a CH_4 and N_2O deficit of 2 g/mi, and a compliance value of 261 g/mi.

[47] Tesla manufactures only electric vehicles. As explained in section 3.C.1, a temporary incentive for electric vehicles allows electric vehicle tailpipe emissions to be set equal to zero grams/mile, as shown in this table. An artifact of this is that Tesla's compliance value is represented by a negative number after applying air conditioning credits.

Table 3-27. 2014 Compliance Values - Passenger Car Fleet (g/mi)

Manufacturer	2-Cycle Tailpipe	Credits (g/mi) FFV	A/C	Off-Cycle	CH_4 & N_2O Deficit	Compliance Value
Aston Martin	454	0	6	0	0	448
BMW	256	0	8	3	1	245
BYD Motors	0	0	0	0	0	0
Ferrari	484	0	11	0	0	473
Fiat Chrysler	298	12	13	3	0	270
Ford	256	9	8	2	0	237
GM	266	10	9	1	0	246
Honda	228	0	3	1	1	226
Hyundai	247	0	5	1	0	241
Jaguar Land Rover	347	17	12	2	0	316
Kia	265	0	5	1	0	259
Lotus	338	0	0	0	0	338
Mazda	220	0	0	0	0	220
McLaren	372	0	0	0	0	372
Mercedes	285	11	10	3	0	262
Mitsubishi	224	0	0	0	0	224
Nissan	229	0	5	1	0	222
Subaru	250	0	1	0	0	249
Tesla[48]	0	0	6	0	0	-6
Toyota	221	0	8	2	0	211
Volvo	288	0	8	0	0	280
Fleet Total	**250**	**5**	**7**	**1**	**0**	**237**

Note: Volkswagen is not included in this table due to an ongoing investigation. Based on the original compliance data, Volkswagen has a passenger car 2-cycle tailpipe value of 266 g/mi, an FFV credit of 10 g/mi, an A/C credit of 8 g/mi, a CH_4 and N_2O deficit of 2 g/mi, and a compliance value of 249 g/mi.

[48] Tesla manufactures only electric vehicles. As explained in section 3.C.1, a temporary incentive for electric vehicles allows electric vehicle tailpipe emissions to be set equal to zero grams/mile, as shown in this table. An artifact of this is that Tesla's compliance value is represented by a negative number after applying air conditioning credits.

Table 3-28. 2014 Compliance Values - Light Truck Fleet (g/mi)

Manufacturer	2-Cycle Tailpipe	Credits (g/mi) FFV	A/C	Off-Cycle	CH_4 & N_2O Deficit	Compliance Value
BMW	312	0	11	6	1	295
Fiat Chrysler	364	19	14	7	0	324
Ford	375	20	10	3	0	342
GM	369	19	11	2	0	337
Honda	299	0	5	2	0	292
Hyundai	325	0	7	3	0	315
Jaguar Land Rover	379	20	22	6	0	332
Kia	330	0	5	1	0	325
Mazda	287	0	0	0	0	287
Mercedes	372	17	12	1	0	342
Mitsubishi	256	0	0	0	0	256
Nissan	335	8	6	2	0	318
Subaru	254	0	2	0	0	252
Toyota	358	15	7	3	0	333
Volvo	348	0	8	0	0	340
Fleet Total	**349**	**14**	**10**	**3**	**0**	**322**

Note: Volkswagen is not included in this table due to an ongoing investigation. Based on the original compliance data, Volkswagen has a light truck 2-cycle tailpipe value of 336 g/mi, an FFV credit of 16 g/mi, an A/C credit of 12 g/mi, a CH4 and N2O deficit of 1 g/mi, and a compliance value of 309 g/mi.

Table 3-29 shows the calculated compliance values for each manufacturer's car and truck fleet for the 2012-2014 model years. As can be seen in the table, the decreases in manufacturer compliance values from 2013 to 2014 outweighed the increases, leading to a net decrease of 5 grams/mile across the fleet of combined cars and trucks.

Table 3-29. 2012-2014 Model Year Compliance Values by Manufacturer and Fleet (g/mi)

	2012 Model Year			2013 Model Year			2014 Model Year		
Manufacturer	**Cars**	**Trucks**	**All**	**Cars**	**Trucks**	**All**	**Cars**	**Trucks**	**All**
Aston Martin				438		438	448		448
BMW	270	353	294	263	335	283	245	295	257
BYD Motors	0		0	0		0	0		0
Coda	0		0	0		0			
Ferrari	484		484	465		465	473		473
Fiat Chrysler	278	353	329	268	348	316	270	324	309
Fisker	146		146						
Ford	248	357	295	240	348	299	237	342	289
GM	264	366	307	254	364	301	246	337	288
Honda	235	315	263	225	307	254	226	292	254
Hyundai	239	305	244	233	310	236	241	315	247
Jaguar Land Rover	371	431	419	337	405	390	316	332	329
Kia	253	321	261	247	293	249	259	325	263
Lotus				334		334	338		338
Mazda	241	324	263	232	296	251	220	287	240
McLaren				374		374	372		372
Mercedes	295	367	320	275	347	299	262	342	284
Mitsubishi	262	283	267	254	267	258	224	256	236
Nissan	256	363	288	228	328	260	222	318	253
Porsche	325	362	342	309	363	336			
Subaru	257	296	282	254	270	264	249	252	251
Suzuki	267	361	287	266	330	273			
Tesla[49]	-6		-6	-6		-6	-6		-6
Toyota	214	339	263	217	332	268	211	334	258
Volvo	286	331	300	282	337	307	280	340	311
Fleet Total	**249**	**348**	**288**	**241**	**338**	**279**	**237**	**322**	**274**

Note: Volkswagen is not included in this table due to an ongoing investigation. Based on the original compliance data, in the 2014 model year Volkswagen had compliance values of 237, 322, and 274 grams/mile for cars, trucks, and all vehicles, respectively.

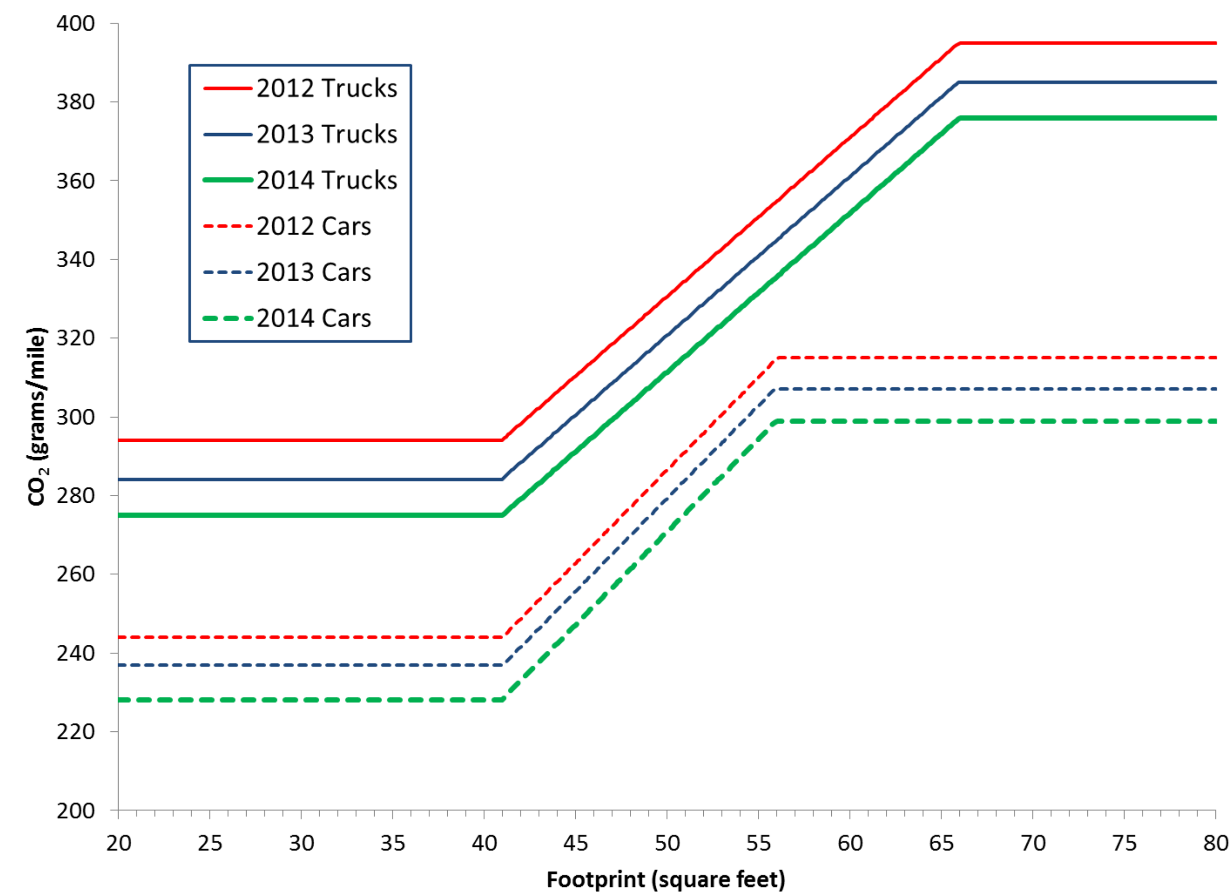
H. 2014 Model Year Footprint-Based CO_2 Standards

The final values needed to determine the relative performance for a manufacturer in a model year are the emissions standards that apply to each manufacturer's fleets in that model year. At the

[49] Tesla manufactures only electric vehicles. As explained in section 3.C.1, a temporary incentive for electric vehicles allows electric vehicle tailpipe emissions to be set equal to zero grams/mile, as shown in this table. An artifact of this is that Tesla's compliance value is represented by a negative number after applying air conditioning credits.

end of each model year, manufacturers calculate unique CO_2 standards for each fleet (cars and trucks) using equations specified in the regulations based on the footprint of their vehicles.[50] The footprint "curves" for the 2012-2014 model years are shown in Figure 3-1. The unique CO_2 standard for each manufacturer's fleet is a production-weighted average of the CO_2 target values determined from the curves based on all of the unique footprint values for the vehicles in a manufacturer's fleet. Trends in the overall average footprint value are thus important because of the direct impact on the stringency of the GHG standards.

Figure 3-1. 2012-2014 Model Year CO_2 Footprint Target Curves



The calculated CO_2 standards for the 2012-2014 model years are shown in Table 3-30. Manufacturers use these unique footprint-based car and truck standards – which are required by regulation – to determine their compliance status. A third value for each manufacturer – a sales- and VMT-weighted standard for the combined car and truck fleet – is provided for convenience and comparative purposes, but it is not a compliance value required by the regulations. Similar to the compliance values described in the previous section, the decreases in the manufacturers' CO_2 standards from 2013 to 2014 outweighed the increases, resulting in an increase in the overall stringency of the program of about 5 grams/mile.

[50] A vehicle's footprint is defined specifically in regulations as the product of vehicle track width and wheelbase, but it can be simply viewed as the area of the rectangle enclosed by the four points where the tires touch the ground.

Table 3-30. 2012-2014 Model Year CO_2 Standards by Manufacturer and Fleet (g/mi)

	2012 Model Year			2013 Model Year			2014 Model Year		
Manufacturer	**Cars**	**Trucks**	**All**	**Cars**	**Trucks**	**All**	**Cars**	**Trucks**	**All**
Aston Martin*				321		321	324		324
BMW	269	336	288	263	324	280	258	313	271
BYD Motors	277		277	269		269	261		261
Coda	246		246	239		239			
Ferrari*	345		345	331		331	324		324
Fiat Chrysler	277	345	323	270	338	311	262	327	309
Fisker	315		315						
Ford	265	364	308	265	355	315	254	345	299
GM	272	369	313	263	360	304	254	357	302
Honda	263	333	288	256	318	278	250	308	275
Hyundai	269	316	273	261	309	263	253	301	257
Jaguar Land Rover*	364	388	383	324	362	353	335	361	357
Kia	266	338	274	258	303	259	251	312	255
Lotus*				311		311	300		300
Mazda	259	323	276	250	311	268	251	300	265
McLaren*				329		329	319		319
Mercedes*	277	360	306	262	354	292	258	330	278
Mitsubishi	261	307	271	249	296	264	236	287	254
Nissan	263	337	285	259	324	280	249	318	271
Porsche	332	422	374	314	410	363			
Subaru	260	309	291	251	299	281	243	289	279
Suzuki	251	325	267	243	296	249			
Tesla	304		304	296		296	288		288
Toyota	264	342	295	257	329	289	250	326	279
Volvo	272	325	288	264	316	288	258	307	283
Fleet Total	**267**	**348**	**299**	**261**	**339**	**292**	**253**	**330**	**287**

Note: Volkswagen is not included in this table due to an ongoing investigation. Based on the original compliance data, in the 2014 model year Volkswagen had CO2 standards of 250, 330, and 287 grams/mile for cars, trucks, and all vehicles, respectively.
*Some or all vehicles subject to temporary less stringent TLAAS standards. See section 3.B.

Overall, the standards decreased by 5 grams/mile from 2013 to 2014, an increase in stringency driven by the more stringent target curves for the 2014 model year. However, the target curves represent only one of several key factors that influence the standards. While increased stringency overall from one year to the next is expected because of the structure of the target curves, there are other contributing factors that can result in – and explain – occasional exceptions that may occur. For example, Table 3-30 shows that the standard for Mazda cars increased – got less stringent – from 2013 to 2014, a phenomenon that is based on an increase of 2 square feet in the average footprint of Mazda cars in the 2014 model year, as seen in Table 3-31.

The average footprint for the overall fleet increased in the 2014 model year by 0.6 square feet, to 49.7 square feet, the highest in the three years of the National Program. The car and truck fleet footprints increased by 0.2 and 0.3 square feet, respectively, but the overall shift by consumers towards trucks contributed substantially to the 0.6 square foot increase of the entire 2014 fleet. Of the 22 manufacturers in the program in 2013 and 2014, fleet average footprint increased for 13, decreased for 3, and was unchanged for 6. Increases in footprint ranged from 0.3 square feet (Ferrari, Volvo) to 2.7 square feet (Jaguar Land Rover). Ford, Mitsubishi, and Subaru defied the industry trend and demonstrated decreases in footprint in their 2014 fleets. Note that an increase in the overall fleet footprint does not necessarily indicate that manufacturers built larger vehicles in 2014; because the footprint is weighted by production volume, an increase could also occur with no change to the vehicles but as a result of increased consumer demand for larger vehicles. Thus, an increase in footprint could be a result of either of these factors independently, or more likely, a mix of both factors.

Table 3-31. Average Footprint by Manufacturer and Fleet (square feet)

	2012 Model Year			2013 Model Year			2014 Model Year			Change: 2013 to 2014		
Manufacturer	**Cars**	**Trucks**	**All**	**Cars**	**Trucks**	**All**	**Cars**	**Trucks**	**All**	**Cars**	**Trucks**	**All**
Aston Martin				45.2		45.2	47.5		47.5	2.3		2.3
BMW	45.9	51.4	47.3	46.2	5 0.8	47.4	47.1	50.4	47.8	0.9	-0.4	0.4
BYD Motors	47.9		47.9	47.9		47.9	47.9		47.9	0		0
Coda	41.5		41.5	41.5		41.5						
Ferrari	47.8		47.8	47.1		47.1	47.4		47.4	0.3		0.3
Fiat Chrysler	47.2	53.6	51.4	47.6	54.5	51.5	48.0	54.1	52.2	0.4	-0.4	0.7
Fisker	58.1		58.1									
Ford	45.3	59.4	50.9	47.0	59.5	53.4	46.4	59.4	52.4	-0.6	-0.1	-1
GM	46.9	60.1	52.0	46.5	60.4	51.9	46.3	62.6	53.2	-0.2	2.2	1.3
Honda	45.0	50.5	46.8	44.9	49.3	46.3	45.6	49.2	47.0	0.7	-0.1	0.7
Hyundai	46.4	46.4	46.4	46.1	47.0	46.2	46.1	47.5	46.2	0	0.5	0
Jaguar Land Rover	51.0	48.4	49.0	50.8	48.2	48.8	49.3	52.0	51.5	-1.5	3.8	2.7
Kia	45.6	51.9	46.2	45.4	45.6	45.4	45.8	50.0	46.1	0.3	4.4	0.6
Lotus				47.1		47.1	43.5		43.5	0		0
Mazda	43.9	48.1	44.9	43.6	47.0	44.4	45.6	47.2	46.0	2	-0.4	1.3
McLaren				46.6		46.6	46.6		46.6	0		0
Mercedes	46.5	51.9	48.2	45.4	51.5	47.3	46.6	51.4	47.8	1.2	-0.1	0.5
Mitsubishi	44.5	44.0	44.4	43.6	43.9	43.7	41.5	44.0	42.3	-2.1	0.1	-1.4
Nissan	45.0	51.6	46.8	45.8	50.8	47.2	45.4	51.6	47.2	-0.4	0.8	0
Porsche	44.7	51.8	47.7	43.7	51.9	47.6						
Subaru	44.3	44.7	44.5	44.0	44.6	44.4	44.1	44.4	44.3	0.1	-0.2	-0.1
Suzuki	42.1	48.7	43.4	41.8	44.0	42.0						
Tesla	53.6		53.6	53.6		53.6	53.6		53.6	0		0
Toyota	45.0	53.4	48.0	45.1	52.5	48.1	45.6	54.1	48.6	0.5	1.6	0.5
Volkswagen	45.0	49.0	45.5	45.2	49.0	45.6	45.5	50.0	46.3	0.3	1	0.7
Volvo	46.8	48.6	47.3	46.8	49.0	47.7	47.2	48.9	48.0	0.4	-0.1	0.3
Fleet Total	**45.7**	**54.5**	**48.8**	**45.9**	**54.8**	**49.1**	**46.1**	**55.0**	**49.7**	**0.2**	**0.3**	**0.6**

I. Overall Compliance Summary

Final compliance for the 2012-2014 model years is summarized in Table 3-32 for the overall model year fleet, and separately for cars and trucks in Tables 3-33 and 3-34, respectively. As in the tables in Section 3.G, these show how the 2-cycle tailpipe values and the credits are used to "build" the overall compliance value, which is then compared to the model year standards described in Section 3.H. The tables also show, in the final column, the value achieved by subtracting the compliance value from the standard, which, for the 2012-2014 model years is a positive value, indicating over-compliance with the standards. Overall, manufacturers outperformed the 2014 standard by 13 grams/mile.[51] In both the 2012 and 2013 model years, the industry's over-compliance was almost entirely driven by the compliance margin seen in the car fleet, since the truck compliance values essentially equaled the overall fleet standards. This was not true for the 2014 model year, where the truck fleet achieved a compliance margin relative to the truck standard of 8 grams/mile, thus contributing to the overall fleet compliance margin.

Table 3-32. Compliance & Credit Summary, 2012-2014 Model Years - Combined Cars and Trucks (g/mi)*

Model Year	2-Cycle Tailpipe	Credits FFV	A/C	Off-Cycle	CH_4 & N_2O Deficit	Compliance Value	Standard	Standard - Compliance
2012	302	8.1	6.1	0.0	0.2	288	299	11
2013	294	7.8	6.9	0.0	0.3	279	292	12
2014	294	8.9	8.3	2.3	0.2	274	287	13

*Values stated in this table and in the text are correct, although rounding of values may result in some apparent differences.

Table 3-33. Compliance & Credit Summary, 2012-2014 Model Years – Passenger Cars (g/mi)*

Model Year	2-Cycle Tailpipe	Credits FFV	A/C	Off-Cycle	CH_4 & N_2O Deficit	Compliance Value	Standard	Standard - Compliance
2012	259	4.0	5.3	0.0	0.1	249	267	17
2013	251	4.0	6.2	0.0	0.3	241	261	20
2014	250	4.6	7.3	1.5	0.3	237	253	16

*Values stated in this table and in the text are correct, although rounding of values may result in some apparent differences.

[51] Note that the rounded values in the tables may produce values that differ from those in the text as a result of rounding. For example, the correct difference between the 2013 standard and compliance values is in fact 12 grams/mile, although the rounded values in the table produce a difference of 13 grams/mile.

Table 3-34. Compliance & Credit Summary, 2012-2014 Model Years – Light Trucks (g/mi)*

Model Year	2-Cycle Tailpipe	Credits			CH_4 & N_2O Deficit	Compliance Value	Standard	Standard - Compliance
		FFV	A/C	Off-Cycle				
2012	369	14.5	7.2	0.0	0.3	348	348	1
2013	360	13.7	7.9	0.0	0.3	338	339	1
2014	349	14.3	9.6	3.4	0.1	322	330	8

*Values stated in this table and in the text are correct, although rounding of values may result in some apparent differences.

A comparison between compliance values and standards for each manufacturer and fleet is shown in Table 3-35. The final row shows values for the total 2014 fleet. The comparison of the compliance and standards in Table 3-35, shown in the "Net Compliance" columns, indicates whether a manufacturer generated net credits or deficits in the 2014 model year. Negative values indicate over-compliance with the standards, or compliance values that are lower than the targets by the stated value. Positive values are thus an indication of compliance values that exceed (i.e., do not comply with) the applicable standards. Kia, for example, generated a 2014 model year deficit because their overall compliance value of 263 grams/mile is above their fleet-wide target of 255 grams/mile. Ford, on the other hand, reported net credits based on a compliance value of 289 grams/mile, 10 grams/mile lower than their fleet-wide standard of 299 grams/mile. Note, however, that the generation of a net deficit in the 2014 model by any manufacturer does not necessarily indicate that the manufacturer has failed to comply with the 2014 model year standards. Kia, for example, will offset their 2014 deficit by using credits generated in previous model years, thereby complying with the 2014 standards.[52] The final row of Table 3-35 shows the conclusion that manufacturers over-complied with the 2014 model year standards by 13 grams/mile. A comparison of the values in the three previous tables to EPA projections for these values is in Appendix A.

[52] This section deals only with manufacturer performance within a model year, and does not consider the implications on compliance of the use of credits or deficits from previous model years or of sold and purchased credits. See Section 5 for a discussion of the current compliance status of each manufacturer that considers all of these factors.

Table 3-35. 2014 Model Year Compliance Summary by Manufacturer and Fleet (g/mi)

	Compliance Value			Standard			Net Compliance		
Manufacturer	**Cars**	**Trucks**	**All**	**Cars**	**Trucks**	**All**	**Cars**	**Trucks**	**All**
Aston Martin	448	0	448	324	0	324	124	0	124
BMW	245	295	257	258	313	271	-13	-18	-14
BYD Motors	0	0	0	261	0	261	-261	0	-261
Ferrari	473	0	473	324	0	324	149	0	149
Fiat Chrysler	270	324	309	262	327	309	8	-3	0
Ford	237	342	289	254	345	299	-17	-3	-10
GM	246	337	288	254	357	302	-8	-20	-14
Honda	226	292	254	250	308	275	-24	-16	-21
Hyundai	241	315	247	253	301	257	-12	14	-10
Jaguar Land Rover	316	332	329	335	361	357	-19	-30	-28
Kia	259	325	263	251	312	255	8	13	8
Lotus	338	0	338	300	0	300	38	0	38
Mazda	220	287	240	251	300	265	-31	-13	-26
McLaren	372	0	372	319	0	319	53	0	53
Mercedes	262	342	284	258	330	278	3	11	5
Mitsubishi	224	256	236	236	287	254	-12	-31	-19
Nissan	222	318	253	249	318	271	-27	0	-18
Subaru	249	252	251	243	289	279	6	-37	-28
Tesla	-6	0	-6	288	0	288	-294	0	-294
Toyota	211	333	258	250	326	279	-39	7	-22
Volvo	280	340	311	258	307	283	22	33	28
Fleet Total	**237**	**322**	**274**	**253**	**330**	**287**	**-16**	**-8**	**-13**

Note: Volkswagen is not included in this table due to an ongoing investigation. Based on the original compliance data, in the 2014 model year Volkswagen had net compliance values of -1, -2, and -1 grams/mile for cars, trucks, and all vehicles, respectively.

4. CREDIT TRANSACTIONS

Credits may be traded among manufacturers with a great deal of flexibility (with the exception of 2009 model year credits and credits generated by manufacturers using the TLAAS program, which are restricted to use only within a manufacturer's own fleets). There are only a few regulatory requirements that relate to credit transactions between manufacturers (other than the restrictions just noted), and these are generally designed to protect those involved in these transactions. While it may seem obvious, it is worth stating that a manufacturer may not trade credits that it does not have. Credits that are available for trade are only those available (1) at the conclusion of a model year when all the data is available with which to calculate the number of credits generated by a manufacturer, and not before; and (2) after a manufacturer has offset any deficits they might have. Credit transactions that result in a negative credit balance for the selling manufacturer are not allowed and can result in severe punitive actions. Although a third party may facilitate transactions, EPA's regulations allow only the automobile manufacturers to engage in credit transactions and hold credits.

Since the 1990's, many of EPA's vehicle emissions regulatory programs have included the flexibilities of averaging, banking, and trading (ABT). The incorporation of ABT provisions in EPA emissions regulations has been generally supported by a wide range of stakeholders: by manufacturers for the increased flexibility that ABT offers and by environmental groups because ABT enhances EPA's ability to introduce standards of greater stringency in an earlier time frame than might otherwise be achieved. Historically, manufacturers tended to make use of the ability to average emissions and bank emissions credits for use in subsequent years, but until recently there has been almost no credit trading activity between companies. The use of trading provisions in EPA's light-duty GHG program is a historic development, and one that EPA welcomes because we believe it will allow greater GHG reductions, lower compliance costs, and greater consumer choice.

The credit transactions reported by manufacturers through the 2014 model year are shown in Table 4-1.[53] As of the close of the 2014 model year, almost 10 million Megagrams of CO_2 credits had changed hands, almost a four-fold increase relative to the volume previously reported. Toyota was a new entrant in the credit transfer market, although the credit recipients remain the same as previously reported. Credit distributions are shown as negative values, in that a disbursement represents a deduction of credits of the specified model year for the selling manufacturer. Credit acquisitions are indicated as positive values because acquiring credits represents an increase in credits for the purchasing manufacturer. The model year represents the "vintage" of the credits that were sold, i.e., the model year from which the credits originated. The vintage always travels with the credits, regardless of when a transaction takes place and in what model year the credits are ultimately used. A manufacturer with 2010 model year credits can hold them until 2021, meaning, for example, that a sale of 2010 credits could potentially be reported to EPA as late as the reporting deadline for the 2021 model year, and those 2010 credits

[53] Manufacturers do not report transactions to EPA as they occur. Thus there may be additional credit transactions that have occurred that are not reported here, but because of the timing of those transactions (after the manufacturers submitted their 2014 model year data) those transactions will be reported in the 2015 model year reports of the manufacturers involved, and thus will be included in EPA's performance report regarding the 2015 model year.

traded in MY 2021 could be used by the buyer to offset deficits from the 2018-2021 model years. The overall impact of these credit transactions on the compliance position of each manufacturer is discussed in Section 5, which pulls together all the credits and deficits, including early credits, discussed in the preceding sections. Note that each value in the table is simply an indication of the quantity of credits from a given model year that has been acquired or disbursed by a manufacturer, and thus may represent multiple transactions with multiple buyers or sellers.

Table 4-1. Reported Credit Sales and Purchases as of the 2014 Model Year (Mg)

		Model Year "Vintage"					
	Manufacturer	**2010**	**2011**	**2012**	**2013**	**2014**	**Total**
Credits Disbursed	Honda	(3,609,383)	-	-	-	-	(3,609,383)
	Nissan	(200,000)	(1,000,000)	(250,000)	-	-	(1,450,000)
	Tesla	(35,580)	(14,192)	(177,941)	(1,048,689)	(1,019,602)	(2,296,004)
	Toyota	(2,507,000)	-	-	-	-	(2,507,000)
Credits Acquired	Ferrari	265,000	-	-	-	-	265,000
	Fiat Chrysler	5,651,383	500,000	-	1,048,689	1,019,602	8,219,674
	Mercedes	435,580	514,192	427,941	-	-	1,377,713

5. Compliance Status After the 2014 Model Year

Based on the information reported to EPA, the vast majority of manufacturers have successfully demonstrated compliance with the 2012-2014 model year standards and are carrying a positive credit balance into the 2015 model year. The manufacturers that report compliance with all model years represent more than 99 percent of all cars and light trucks produced for U.S. sale in these first three model years of EPA's GHG standards. Table 5-1 shows one view of the accumulated credits for each manufacturer. Each manufacturer reporting a positive balance in the final column is, by definition, in compliance with the 2012-2014 model years (because all deficits must be offset before carrying credits forward).

Table 5-1 shows the total credits (or deficits) for each manufacturer in the last column. Table 5-1 also shows the credits (or deficits) generated by each manufacturer in the 2009-2014 model years, as well as the net impact of credit transactions on each manufacturer's credit balance. However, to fully understand the current compliance position of each manufacturer, we also need to know the makeup of the credit balance in terms of the origin, or vintage, of the credits. Knowing the vintage is important both for credits and deficits, because we need to know when credits expire and must be forfeited, and we need to know when a manufacturer is in violation of the regulations as a result of failing to offset a deficit within the required time frame.

Ferrari, as shown in Table 5-1, is a relatively simple example. They purchased 265,000 Mg of 2010 credits (we know the vintage from Section 4). These credits were more than sufficient to offset their total accumulated deficits from the 2012-2014 model years, leaving them with credits remaining (from the 2010 model year). Because Ferrari generated deficits in the 2012-2014 model years that they subsequently erased with purchased credits, Ferrari has complied with the 2012-2014 standards.

Table 5-1. Cumulative Credit Status After the 2014 Model Year (Mg)

	Early Credits (2009-2011)		2012		2013		2014		
Manufacturer	**Earned**	**Bought, Sold, or Expired**	**Earned**	**Bought or Sold**	**Earned**	**Bought, Sold, or Forfeited**	**Earned**	**Bought or Sold**	**Total Carried Forward to 2015**
Toyota	80,435,498	(32,030,399)	13,163,009	0	9,885,788	0	9,817,927	0	81,271,823
Honda	35,855,532	(17,742,736)	7,789,618	0	7,089,732	0	6,240,864	0	39,233,010
GM	24,564,829	(6,473,623)	2,872,354	0	1,748,357	0	7,668,105	0	30,380,022
Ford	16,075,888	(5,882,011)	4,641,001	0	7,829,549	0	4,844,627	0	27,509,054
Hyundai	14,007,495	(4,476,176)	3,535,510	0	5,777,836	(169,775)*	1,052,474	0	19,727,364
Nissan	18,131,200	(9,390,124)	(729,937)	(250,000)	5,190,521	0	4,859,073	0	17,810,733
Fiat Chrysler	9,110,207	6,151,383	(1,892,184)	0	(1,631,285)	1,048,689	(46,836)	1,019,602	13,759,576
Subaru	5,755,171	(491,789)	646,317	0	1,444,372	0	2,882,640	0	10,236,711
Kia	10,444,192	(2,282,680)	1,303,379	0	1,330,236	(123,956)*	(852,095)	0	9,819,076
Mazda	5,482,642	(1,390,883)	734,887	0	786,431	0	1,547,009	0	7,160,086
BMW	1,004,292	0	(287,861)	0	(259,619)	0	1,075,752	0	1,532,564
Mitsubishi	1,449,336	(583,146)	57,837	0	58,209	0	351,031	0	1,333,267
Suzuki	876,650	(265,311)	(127,699)	0	(55,398)	0	0	0	428,242
Mercedes	378,272	949,772	(748,793)	427,941	(377,880)	0	(401,140)	0	228,172
Ferrari	0	265,000	(40,983)	0	(49,670)	0	(66,734)	0	107,613
Volvo	730,187	0	(175,195)	0	(297,006)	0	(183,695)	0	74,291
Fisker	0	0	46,694	0	0	0	0	0	46,694
Coda	0	0	5,524	0	1,727	0	0	0	7,251
BYD Motors	0	0	595	0	1,681	0	2,548	0	4,824
Tesla	49,772	(49,772)	178,517	(177,941)	1,049,384	(1,048,689)	1,020,296	(1,019,602)	1,965
Lotus	0	0	0	0	(763)	0	(2,078)	0	(2,841)
McLaren	0	0	0	0	(3,620)	0	(2,887)	0	(6,507)
Aston Martin	3,332	0	0	0	(8,315)	0	(30,861)	0	(35,844)
Jaguar Land Rover	0	0	(424,032)	0	(503,111)	0	417,398	0	(509,745)
Fleet Total	**230,795,900**	**(74,843,471)**	**30,046,063**	**0**	**38,858,207**	**(293,731)**	**40,305,646**	**0**	**264,868,614**

Note: Volkswagen is not included in this table due to an ongoing investigation. Based on the original compliance data, Volkswagen earned 112,228 Mg of credits in model year 2014 and will carry 4,751,213 Mg into model year 2015.

*Forfeited per the requirements of a federal Consent Decree.

Because manufacturers accumulate car and truck credits separately, and because they are allowed to move credits around between cars and trucks, the situation can get far more complex than seen in the Ferrari example.[54] Consider this example, where a manufacturer generates 1500 Mg of car credits and a -500 Mg deficit in trucks in 2012, and where credits all have a 5-year lifespan:

Fleet	2012 Credits (Mg)
Cars	1500
Trucks	-500
Total	**1000**

The manufacturer must use the car credits to offset the truck deficit in this case, because there are no credits available from prior model years to use, and credits cannot be carried forward until deficits are addressed. Thus the manufacturer carries a balance of 1000 Mg of credits from 2012 into 2013. Then in this example let's assume that in 2013 they generate 1000 Mg of credits in the car fleet and a deficit of -1000 Mg in the truck fleet, as shown below:

Fleet	2012 Credits (Mg)	2013 Credits (Mg)
Cars	1500	1000
Trucks	-500	-1000
Total	**1000**	**0**

Here, the manufacturer would have 1000 Mg of 2012 credits

There are multiple choices for a manufacturer faced with such a situation. As shown above, all deficits are adequately addressed within each model year, and a manufacturer could leave it at that. Doing so would mean carrying forward the 1000 Mg of credits remaining from 2012 into 2014. There is, however, a smarter – but not mandatory – option. Because the regulations allow car and truck credits and deficits to be managed as separate "bins," and because newer credits are generally more valuable than older credits (because they last longer) it would be smarter for this manufacturer to use the 1000 Mg of credits from 2012 to offset the deficit of -1000 Mg in the 2013 truck fleet, as shown below:

Fleet	2012 Credits (Mg)	2013 Credits (Mg)
Cars	1500	1000
Trucks	-500	-1000
Total	**1000**	**1000**

Here, the manufacturer would have 1000 Mg of 2013

The bottom line remains the same (1000 Mg of credits are carried into 2014), except that in this case the credits carried forward have a vintage from the newer 2013 model year. Theoretically, a manufacturer could use any mix of 2012 and 2013 credits to offset the 2013 truck deficit, in which case the credits remaining to carry forward would be a mix of 2012 and 2013 credits. The value of a given vintage is based on its expiration date, and the expiration date of 2010-2016

[54] Note that the regulations require that all credits and deficits within a vehicle class (passenger cars or light trucks) be aggregated before transfers between vehicle classes may occur. See 40 CFR 86.1865-12(k)(5).

model year credits in EPA's GHG program is fixed at the 2021 model year, meaning that for the 2010-2016 model years it is less important to treat credits in this way. Nevertheless, this "first in, first out" accounting method is being used to determine the makeup of credit balances held by manufacturers (unless a manufacturer expresses a preference for an alternative accounting). It is challenging to display all the credit transfers, transactions, and vintages in a single data table in an easily understandable manner. However, we can display the current state of each manufacturer and the vintage of all the credits currently held by each manufacturer.

Table 5-2 reveals the credit balances for each manufacturer, after adjusting for credit transactions and transfers, by the vintage of the credits reported by the manufacturer. The model year column headings represent the vintages that make up the total credits (or deficit) being carried forward into the 2015 model year. This table shows, for example, the extent to which some manufacturers have used credits from prior model years. Volvo, for example, reported generating about 730,000 early credits (see Table 2-1). They have used all the 2009 and 2010 credits and most of the 2011 credits to offset deficits in the 2012-2014 model years, and thus carrying a positive balance into the 2015 model year. There are four manufacturers – Lotus, McLaren, Aston Martin, and Jaguar Land Rover – carrying a deficit into the 2015 model year, meaning that they have not yet established compliance in all previous model years.   Lotus and McLaren have deficits from both the 2013 and 2014 model years to resolve, while Aston Martin used early credits to comply with their 2013 standard and thus is only in deficit for the 2014 model year. Jaguar Land Rover generated credits in the 2014 model year, which were used to offset deficits from early model years, although not entirely, as shown by the deficit remaining from 2013. A deficit may be carried forward for three years after the year in which it is generated, meaning that deficits from the 2013 model year must be reconciled by the end of the 2016 model year.

Note that Tables 5-1 and 5-2 over-simplify the data with respect to the manufacturers using the TLAAS program in order to present the data concisely. Jaguar Land Rover and Mercedes have vehicles subject to the primary standards and subject to the less stringent TLAAS standards, yet for the purpose of these tables we have aggregated the credits accumulated in both the primary and TLAAS fleets into a single row in the table. Although they are not separated for the purposes of these tables, EPA maintains careful records (as do the manufacturers) of the credits within the Primary and TLAAS programs, as is necessary because of the different treatment and restrictions for the different fleets. The data we are making available online and in this report will identify the source of each credit (e.g., whether from the Primary or TLAAS fleets).

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Table 5-2. Credits Available After the 2014 Model Year, Reflecting Trades & Transfers (Mg)

Manufacturer	2010	2011	2012	2013	2014	Total Carried Forward to 2015
Toyota	31,950,797	14,651,963	13,163,009	10,552,864	10,953,190	81,271,823
Honda	10,573,046	7,539,750	7,789,618	7,089,732	6,240,864	39,233,010
GM	11,073,134	6,184,049	2,872,354	2,582,380	7,668,105	30,380,022
Ford	7,416,966	2,776,911	4,641,001	7,829,549	4,844,627	27,509,054
Hyundai	5,388,593	4,012,969	3,535,510	5,613,813	1,176,479	19,727,364
Nissan	5,581,739	852,749	989,226	5,510,993	4,876,026	17,810,733
Kia	2,651,872	4,657,545	1,303,379	1,206,280	0	9,819,076
Subaru	2,225,296	2,876,413	646,317	1,487,331	3,001,354	10,236,711
Fiat Chrysler	7,832,726	2,605,453	0	1,366,157	1,955,240	13,759,576
Mazda	3,201,708	875,213	749,725	786,431	1,547,009	7,160,086
Mitsubishi	521,776	302,394	67,976	90,090	351,031	1,333,267
Suzuki	329,382	98,860	0	0	0	428,242
BMW	141,255	315,557	0	0	1,075,752	1,532,564
Volvo	0	74,291	0	0	0	74,291
Mercedes	0	0	141,497	25,755	60,920	228,172
Fisker	0	0	46,694	0	0	46,694
Coda	0	0	5,524	1,727	0	7,251
BYD Motors	0	0	595	1,681	2,548	4,824
Tesla	0	0	576	695	694	1,965
Ferrari	107,613	0	0	0	0	107,613
Lotus	0	0	0	(763)	(2,078)	(2,841)
McLaren	0	0	0	(3,620)	(2,887)	(6,507)
Aston Martin	0	0	0	(4,983)	(30,861)	(35,844)
Jaguar Land Rover	0	0	0	(509,745)	0	(509,745)
Fleet Total	**91,807,566**	**49,352,549**	**36,027,077**	**43,851,181**	**43,830,241**	**264,868,614**

Note: Volkswagen is not included in this table due to an ongoing investigation. Based on the original compliance data, Volkswagen will carry 4,751,213 Mg into model year 2015.

APPENDIX A: COMPARING ACTUAL PERFORMANCE TO RULEMAKING PROJECTIONS

As described in Section 1, EPA's GHG program was promulgated in two regulatory actions conducted jointly with NHTSA. The first rulemaking established standards for the 2012-2016 model years, and the second rulemaking set standards for the 2017 and later model years. [55] [56] In each of these rulemakings we included tables summarizing our projections of what the fleet-wide standards would be and how we expected manufacturers would comply with the standards. When evaluating these projections and how they compare to the actual performance as described in this report, consider that the projections for the 2012-2016 model years were finalized in early 2010, and the 2017 and later projections were determined in the middle of 2012. The projections were made with the best available information at the time, but it should not be surprising that actual performance differs from the rulemaking projections. Factors such as consumer preferences, technology innovation, fuel prices, and manufacturer behavior can change in unanticipated ways, leading current, actual performance to diverge from projections made in the past. While a comparison of actual performance to projections is interesting, and helps illuminate whether or not the program is achieving its expected benefits, this is secondary in the context of this report, which is focused on actual compliance. Compliance of manufacturers with EPA's standards is not determined by comparing current model year results to past projections, but is instead determined by comparing achieved compliance values to the regulatory footprint-based standards covered in Sections 1-5 of this report.

Table A-1 shows key projected values for the combined car and truck fleet for the 2012-2025 model years. All of the values in this table (and Tables A-2 and A-3) come directly from the regulatory actions noted above. Note that we projected that the industry, on average, would comply exactly with the target, i.e., the compliance value equals the target value in each model year. This table illustrates a fundamental principle: EPA projections from the rulemaking analysis assumed manufacturers would achieve significant GHG emission reductions (and hence compliance) through a variety of technologies. In the early years, until the incentive is phased out in the 2016 model year, we projected significant production of flexible fuel vehicles (FFV). We also projected relatively high production of reduced GHG air conditioning systems across the fleet, resulting in reductions ranging from 3.5 grams/mile in 2012 and increasing to over 20 grams/mile late in the program. As shown in Table A-1, we projected that manufacturers would start with a 2-cycle tailpipe value of 290 grams/mile in the 2014 model year, reducing that by total credits and incentives of about 14 grams/mile, thus yielding a net compliance value of 276 grams/mile. We did not make any estimations of the use of N_2O and CH_4 alternative standards for two reasons: (1) the overall impact was expected to be very small, and (2) manufacturers are required to offset deficits accumulated with CO_2-equivalent credits as a result of using this flexibility, thus there is no net impact on the program.

[55] Proposed Rulemaking to Establish Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards, Proposed Rule, Federal Register 74 (28 September 2009): 49454-49789.
[56] 2017 and Later Model Year Light-Duty Vehicle Greenhouse Gas Emissions and Corporate Average Fuel Economy Standards, Final Rule, Federal Register 77 (15 October 2012): 62889.

Tables A-2 and A-3 show the same projected values as Table A-1, but separately for cars and trucks, respectively. In the regulatory action establishing the standards we did not publish car- and truck-specific estimated values for the 2-cycle tailpipe emissions or the use of credits and incentives in the 2012-2015 model years, thus these values are shown as N/A in these tables.

Table A-1. Projected CO_2 Performance in Rulemaking Analyses for the Combined Passenger Car and Light Truck Fleet (g/mi)

Model Year	2-Cycle Tailpipe Emissions	FFV Credit	A/C Credit	TLAAS Credit	Off-Cycle Credit	N_2O & CH_4 Deficit	Compliance	Standard
2012	307	6.5	3.5	1.2	0.0	N/A	295	295
2013	298	5.8	5.0	0.9	0.0	N/A	286	286
2014	290	5.0	7.5	0.6	0.0	N/A	276	276
2015	277	3.7	10.0	0.3	0.0	N/A	263	263
2016	261	0.0	10.6	0.1	0.5	N/A	250	250
2017	256	0.0	12.5	0.0	0.6	N/A	243	243
2018	249	0.0	14.9	0.0	0.8	N/A	234	234
2019	242	0.0	17.5	0.0	0.9	N/A	223	223
2020	234	0.0	19.2	0.0	1.0	N/A	214	214
2021	222	0.0	20.8	0.0	1.1	N/A	200	200
2022	212	0.0	20.8	0.0	1.4	N/A	190	190
2023	203	0.0	20.8	0.0	1.7	N/A	181	181
2024	194	0.0	20.6	0.0	1.9	N/A	172	172
2025	186	0.0	20.6	0.0	2.3	N/A	163	163

Table A-2. Projected CO_2 Performance in Rulemaking Analyses for Passenger Cars (g/mi)

Model Year	2-Cycle Tailpipe Emissions	FFV Credit	A/C Credit	TLAAS Credit	Off-Cycle Credit	N_2O & CH_4 Deficit	Compliance	Standard
2012	N/A	N/A	N/A	N/A	N/A	N/A	263	263
2013	N/A	N/A	N/A	N/A	N/A	N/A	256	256
2014	N/A	N/A	N/A	N/A	N/A	N/A	247	247
2015	N/A	N/A	N/A	N/A	N/A	N/A	236	236
2016	235	0.0	10.2	0.0	0.4	N/A	225	225
2017	226	0.0	12.8	0.0	0.5	N/A	213	213
2018	218	0.0	14.3	0.0	0.6	N/A	203	203
2019	210	0.0	15.8	0.0	0.7	N/A	193	193
2020	201	0.0	17.3	0.0	0.8	N/A	183	183
2021	193	0.0	18.8	0.0	0.8	N/A	173	173
2022	184	0.0	18.8	0.0	0.9	N/A	164	164
2023	177	0.0	18.8	0.0	1.0	N/A	157	157
2024	170	0.0	18.8	0.0	1.1	N/A	150	150
2025	163	0.0	18.8	0.0	1.4	N/A	143	143

Table A-3. Projected CO_2 Performance in Rulemaking Analyses for Light Trucks (g/mi)

Model Year	2-Cycle Tailpipe Emissions	FFV Credit	A/C Credit	TLAAS Credit	Off-Cycle Credit	N_2O & CH_4 Deficit	Compliance	Standard
2012	N/A	N/A	N/A	N/A	N/A	N/A	346	346
2013	N/A	N/A	N/A	N/A	N/A	N/A	337	337
2014	N/A	N/A	N/A	N/A	N/A	N/A	326	326
2015	N/A	N/A	N/A	N/A	N/A	N/A	312	312
2016	310	0.0	11.4	0.0	0.7	N/A	298	298
2017	308	0.0	12.0	0.0	0.9	N/A	295	295
2018	304	0.0	16.0	0.0	1.0	N/A	287	287
2019	299	0.0	20.6	0.0	1.2	N/A	278	278
2020	294	0.0	22.5	0.0	1.4	N/A	270	270
2021	276	0.0	24.4	0.0	1.5	N/A	250	250
2022	264	0.0	24.4	0.0	2.2	N/A	238	238
2023	253	0.0	24.4	0.0	2.9	N/A	226	226
2024	242	0.0	24.4	0.0	3.6	N/A	214	214
2025	233	0.0	24.4	0.0	4.3	N/A	204	204

Table A-4 shows a comparison of the projected values (in Tables A-1, A-2, and A-3) with the actual performance for the 2012-2014 model years for the combined car and truck fleet. As is the case throughout this report, values for the combined fleet of cars and trucks are calculated as a weighted average of the individual car and truck fleet values. However, the methodology used for weighting and combining car and truck values in this section differs from the methodology used elsewhere in this report. As noted in Chapter 1, the general methodology used in this report to create a complete fleet value from separate car and truck fleet values incorporates weighting by the relative lifetime vehicle miles traveled (VMT) of cars and trucks (lifetime VMT values for cars and trucks are specified in the regulations as 195,264 and 225,865 miles, respectively). Because credits are calculated based on differing car and truck VMT values, the methodology for combining car and truck grams/mile values must include weighting by VMT for the result to be internally and mathematically consistent with the total Megagrams of credits generated by the fleet. However, past rulemaking projections for the combined car and truck fleet were determined by weighting car and truck fleet values by their relative production only, ignoring the impact of VMT. In order to provide an accurate comparison, the actual performance values in Table A-4 are calculated in the same manner as the projected values: without weighting by VMT. For this reason the actual values in Table A-4 are not the same as values with the same labels presented elsewhere in this report. For example, the 2012 model year 2-cycle tailpipe value in Table A-4 is 299 grams/mile, whereas the same metric is shown as 302 grams/mile in Table 3-1. Both of these values are correct, as the former is not VMT-weighted and the latter is VMT-weighted. It is only within this section that a different methodology is used, specifically to facilitate an apples-to-apples comparison between actual fleet performance and EPA's projections. Note that values for the car and truck fleets are identical to those shown elsewhere in the report; only the values for the combined fleet will differ based on the different methods of calculating combined values from the individual car and truck values.

Table A-4 shows that actual industry-wide compliance targets for the combined car and truck fleets are slightly higher than EPA's projections for both model year 2012 (by 1 gram/mile) and model year 2013 (by 3 grams/mile). This gap grew further in the 2014 model year, to 8 grams/mile, likely because industry-wide footprint values and the truck fraction of the fleet are higher than projected in the rulemaking analyses (for more information on footprint trends, see EPA's CO_2 and Fuel Economy Trends report at epa.gov/otaq/fetrends.htm).

More important, however, is that despite these slightly higher targets, actual industry-wide 2-cycle tailpipe emissions and overall compliance values have been consistently lower than projected in the EPA rulemaking analyses. Actual industry-wide 2-cycle tailpipe emissions performance was 8-9 grams/mile lower than the projected values in the 2012 and 2013 model years, and 5 grams/mile lower in the 2014 model year. Accounting for slightly higher flexible fuel vehicle and air conditioning credits and slightly lower TLAAS credits than projected, the actual industry-wide compliance values were 11 grams/mile lower in model year 2012 and 10 grams/mile lower in model year 2013, relative to the rulemaking projections. Although this gap shrunk in 2014 to 5 grams/mile, this means that, other things being equal (such as new vehicle sales and VMT), the aggregate CO_2 emissions reductions from the first three years of the program have been larger than projected by EPA in the rulemaking analyses. It also reinforces that the industry had a compliance "cushion" in these three years, and is earning credits that are being banked for possible future use.

Tables A-5 and A-6 provide comparative data separately for cars and trucks for the 2012-2014 model years (though projected values for use of credits by vehicle category are not available until model year 2016). For cars, the directional impacts are similar to those for the combined car and truck fleet, i.e., the actual targets are higher than projected and the actual compliance values are much lower (10 grams/mile in 2014). The actual targets are also higher than the projected targets for the truck fleet, but in this case the actual compliance values are slightly higher than projected in the 2012 and 2013 model years and lower than projected in the 2014 model year.

Table A-4. Actual and Projected CO_2 Values, Cars and Trucks Combined (g/mi)

	ACTUAL								PROJECTED							
Model Year	2-Cycle Tailpipe	FFV Credit	A/C Credit	TLAAS Credit	Off-Cycle Credit	N_2O & CH_4 Deficit	Compliance	Target	2-Cycle Tailpipe	FFV Credit	A/C Credit	TLAAS Credit	Off-Cycle Credit	N_2O & CH_4 Deficit	Compliance	Target
2012	298	7.8	6.0	0.6	0.0	0.2	284	296	307	6.5	3.5	1.2	0.0	N/A	295	295
2013	290	7.5	6.8	0.6	0.0	0.3	276	289	298	5.8	5.0	0.9	0.0	N/A	286	286
2014	290	8.6	8.3	0.3	2.3	0.2	271	284	290	5.0	7.5	0.6	0.0	N/A	276	276

Table A-5. Actual and Projected CO_2 Values, Passenger Cars (g/mi)

	ACTUAL								PROJECTED							
Model Year	2-Cycle Tailpipe	FFV Credit	A/C Credit	TLAAS Credit	Off-Cycle Credit	N_2O & CH_4 Deficit	Compliance	Target	2-Cycle Tailpipe	FFV Credit	A/C Credit	TLAAS Credit	Off-Cycle Credit	N_2O & CH_4 Deficit	Compliance	Target
2012	259	4.0	5.3	0.3	0.0	0.1	249	267	N/A	N/A	N/A	N/A	0.0	N/A	263	263
2013	251	4.0	6.2	0.2	0.0	0.3	241	261	N/A	N/A	N/A	N/A	0.0	N/A	256	256
2014	250	4.6	7.3	0.2	1.5	0.3	237	253	N/A	N/A	N/A	N/A	0.0	N/A	247	247

Table A-6. Actual and Projected CO_2 Values, Light Trucks (g/mi)

	ACTUAL								PROJECTED							
Model Year	2-Cycle Tailpipe	FFV Credit	A/C Credit	TLAAS Credit	Off-Cycle Credit	N_2O & CH_4 Deficit	Compliance	Target	2-Cycle Tailpipe	FFV Credit	A/C Credit	TLAAS Credit	Off-Cycle Credit	N_2O & CH_4 Deficit	Compliance	Target
2012	369	14.5	7.2	1.2	0.0	0.3	348	348	N/A	N/A	N/A	N/A	0.0	N/A	346	346
2013	360	13.7	7.9	1.2	0.0	0.3	338	339	N/A	N/A	N/A	N/A	0.0	N/A	337	337
2014	349	14.3	9.6	0.6	3.4	0.1	322	330	N/A	N/A	N/A	N/A	0.0	N/A	326	326

APPENDIX B: VEHICLE PRODUCTION VOLUME & MARKET SHARE

Table B-1. Vehicle Production Volume by Manufacturer and Vehicle Category

	Model Year 2012			Model Year 2013			Model Year 2014		
Manufacturer	**Car**	**Truck**	**All**	**Car**	**Truck**	**All**	**Car**	**Truck**	**All**
Aston Martin[A]				364	-	364	1,272	-	1,272
BMW	191,154	65,856	257,010	303,319	98,969	402,288	297,388	81,938	379,326
BYD Motors	11	-	11	32	-	32	50	-	50
Coda	115	-	115	37	-	37			
Ferrari	1,510	-	1,510	1,902	-	1,902	2,301	-	2,301
Fiat Chrysler	538,887	994,996	1,533,883	654,845	852,653	1,507,498	648,377	1,446,365	2,094,742
Fisker	1,415	-	1,415						
Ford	1,052,721	701,602	1,754,323	1,166,975	1,234,018	2,400,993	1,258,732	1,075,502	2,334,234
GM	1,449,244	915,130	2,364,374	1,432,131	913,765	2,345,896	1,556,701	1,164,610	2,721,311
Honda	1,047,165	493,414	1,540,579	1,021,800	472,569	1,494,369	868,337	577,828	1,446,165
Hyundai	580,904	46,097	627,001	1,061,950	38,073	1,100,023	509,920	38,441	548,361
Jaguar Land Rover	12,769	41,792	54,561	16,051	47,532	63,583	12,323	55,233	67,556
Kia	443,751	49,250	493,001	611,414	16,980	628,394	507,630	28,757	536,387
Lotus[A]				170	-	170	280	-	280
Mazda	213,308	65,696	279,004	164,862	61,093	225,955	217,333	78,826	296,159
McLaren[A]				412	-	412	279	-	279
Mercedes	173,832	81,573	255,405	207,957	89,041	296,998	278,126	92,312	370,438
Mitsubishi	51,927	12,540	64,467	32,654	13,754	46,408	60,679	29,828	90,507
Nissan	896,278	331,886	1,228,164	919,647	372,970	1,292,617	935,995	389,639	1,325,634
Porsche[B]	16,946	12,927	29,873	22,021	19,461	41,482			
Subaru	106,152	163,860	270,012	145,705	211,326	357,031	109,078	356,818	465,896
Suzuki	25,266	5,997	31,263	10,427	1,116	11,543			
Tesla	2,952	-	2,952	17,813	-	17,813	17,791	-	17,791
Toyota	1,298,021	722,227	2,020,248	1,347,436	915,658	2,263,094	1,420,641	772,809	2,193,450
Volkswagen	500,690	64,882	565,572	559,448	68,414	627,862	487,086	103,524	590,610
Volvo	52,375	19,432	71,807	42,072	31,282	73,354	16,526	15,063	31,589
All	**8,657,393**	**4,789,157**	**13,446,550**	**9,741,444**	**5,458,674**	**15,200,118**	**9,206,845**	**6,307,493**	**15,514,338**

[A] *Exempt from compliance with 2012 model year standards.*

[B] *Aggregated with Volkswagen starting with the 2014 model year.*

Table B-2. Vehicle Category Market Share by Manufacturer and Model Year (%)

Manufacturer	2012		2013		2014	
	Car %	Truck %	Car %	Truck %	Car %	Truck %
Aston Martin[A]			100%	0%	100%	0%
BMW	74%	26%	75%	25%	78%	22%
BYD Motors	100%	0%	100%	0%	100%	0%
Coda	100%	0%	100%	0%		
Ferrari	100%	0%	100%	0%	100%	0%
Fiat Chrysler	35%	65%	43%	57%	31%	69%
Fisker	100%	0%				
Ford	60%	40%	49%	51%	54%	46%
GM	61%	39%	61%	39%	57%	43%
Honda	68%	32%	68%	32%	60%	40%
Hyundai	93%	7%	97%	3%	93%	7%
Jaguar Land Rover	23%	77%	25%	75%	18%	82%
Kia	90%	10%	97%	3%	95%	5%
Lotus[A]			100%	0%	100%	0%
Mazda	76%	24%	73%	27%	73%	27%
McLaren[A]			100%	0%	100%	0%
Mercedes	68%	32%	70%	30%	75%	25%
Mitsubishi	81%	19%	70%	30%	67%	33%
Nissan	73%	27%	71%	29%	71%	29%
Porsche	57%	43%	53%	47%		
Subaru	39%	61%	41%	59%	23%	77%
Suzuki	81%	19%	90%	10%		
Tesla	100%	0%	100%	0%	100%	0%
Toyota	64%	36%	60%	40%	65%	35%
Volkswagen	89%	11%	89%	11%	82%	18%
Volvo	73%	27%	57%	43%	52%	48%
All	**64%**	**36%**	**64%**	**36%**	**59%**	**41%**

[A] *Exempt from compliance with 2012 model year standards.*

APPENDIX C: 2012-2013 MODEL YEAR COMPLIANCE VALUES

Table C-1. 2012 Compliance Values - Combined Passenger Car & Light Truck Fleet (g/mi)

Manufacturer	2-Cycle Tailpipe	Credits (g/mi)			CH_4 & N_2O Deficit	Compliance Value
		FFV	A/C	Off-Cycle		
BMW	302	0	8	0	0	294
BYD Motors	0	0	0	0	0	0
Coda	0	0	0	0	0	0
Ferrari	494	0	10	0	0	484
Fiat Chrysler	357	18	10	0	0	329
Fisker	146	0	0	0	0	146
Ford	315	14	6	0	1	295
GM	331	16	8	0	0	307
Honda	266	0	3	0	0	263
Hyundai	249	0	4	0	0	244
Jaguar Land Rover	426	0	7	0	0	419
Kia	266	0	5	0	0	261
Mazda	263	0	0	0	0	263
Mercedes	343	13	10	0	0	320
Mitsubishi	267	0	0	0	0	267
Nissan	295	4	3	0	0	288
Porsche	342	0	0	0	0	342
Subaru	282	0	2	0	0	280
Suzuki	287	0	0	0	0	287
Tesla	0	0	6	0	0	-6
Toyota	273	4	7	0	0	263
Volvo	311	0	11	0	0	300
Fleet Total	**302**	**8**	**6**	**0**	**0**	**288**

Note: Volkswagen is not included in this table due to an ongoing investigation. Based on the original compliance data, Volkswagen has a 2-cycle tailpipe value of 281 g/mi, an FFV credit of 1 g/mi, an A/C credit of 7 g/mi, a CH_4 and N_2O deficit of 2 g/mi, and a compliance value of 276 g/mi.

Table C-2. 2012 Compliance Values - Passenger Car Fleet (g/mi)

Manufacturer	2-Cycle Tailpipe	Credits (g/mi) FFV	A/C	Off-Cycle	CH_4 & N_2O Deficit	Compliance Value
BMW	277	0	7	0	0	270
BYD Motors	0	0	0	0	0	0
Coda	0	0	0	0	0	0
Ferrari	494	0	10	0	0	484
Fiat Chrysler	300	13	9	0	0	278
Fisker	146	0	0	0	0	146
Ford	261	9	5	0	0	248
GM	283	11	8	0	0	264
Honda	237	0	2	0	0	235
Hyundai	243	0	4	0	0	239
Jaguar Land Rover	376	0	5	0	0	371
Kia	258	0	5	0	0	253
Mazda	241	0	0	0	0	241
Mercedes	316	11	9	0	0	295
Mitsubishi	262	0	0	0	0	262
Nissan	258	0	2	0	0	256
Porsche	325	0	0	0	0	325
Subaru	257	0	2	0	0	255
Suzuki	267	0	0	0	0	267
Tesla	0	0	6	0	0	-6
Toyota	221	0	7	0	0	214
Volvo	297	0	11	0	0	286
Fleet Total	**259**	**4**	**5**	**0**	**0**	**249**

Note: Volkswagen is not included in this table due to an ongoing investigation. Based on the original compliance data, Volkswagen has a passenger car 2-cycle tailpipe value of 274 g/mi, an FFV credit of 1 g/mi, an A/C credit of 6 g/mi, a CH_4 and N_2O deficit of 2 g/mi, and a compliance value of 269 g/mi.

Table C-3. 2012 Compliance Values - Light Truck Fleet (g/mi)

Manufacturer	2-Cycle Tailpipe	Credits (g/mi) FFV	A/C	Off-Cycle	CH_4 & N_2O Deficit	Compliance Value
BMW	363	0	11	0	1	353
Fiat Chrysler	384	21	10	0	0	353
Ford	385	21	8	0	1	357
GM	397	23	8	0	0	366
Honda	320	0	5	0	0	315
Hyundai	312	0	7	0	0	305
Jaguar Land Rover	439	0	8	0	0	431
Kia	324	0	3	0	0	321
Mazda	324	0	0	0	0	324
Mercedes	393	15	11	0	0	367
Mitsubishi	283	0	0	0	0	283
Nissan	382	15	4	0	0	363
Porsche	362	0	0	0	0	362
Subaru	296	0	2	0	0	294
Suzuki	361	0	0	0	0	361
Toyota	354	9	6	0	0	339
Volvo	343	0	12	0	0	331
Fleet Total	**369**	**14**	**7**	**0**	**0**	**348**

Note: Volkswagen is not included in this table due to an ongoing investigation. Based on the original compliance data, Volkswagen has a light truck 2-cycle tailpipe value of 330 g/mi, an FFV credit of 0 g/mi, an A/C credit of 9 g/mi, a CH4 and N2O deficit of 1 g/mi, and a compliance value of 322 g/mi.

Table C-4. 2013 Compliance Values - Combined Passenger Car & Light Truck Fleet (g/mi)

Manufacturer	2-Cycle Tailpipe	Credits (g/mi) FFV	Credits (g/mi) A/C	Credits (g/mi) Off-Cycle	CH_4 & N_2O Deficit	Compliance Value
Aston Martin	444	0	6	0	0	438
BMW	292	0	9	0	0	283
BYD Motors	0	0	0	0	0	0
Coda	0	0	0	0	0	0
Ferrari	475	0	10	0	0	465
Fiat Chrysler	344	17	10	0	0	316
Ford	321	15	8	0	1	299
GM	325	15	9	0	0	301
Honda	257	0	4	0	1	254
Hyundai	241	0	5	0	0	236
Jaguar Land Rover	399	1	8	0	0	390
Kia	254	0	5	0	0	249
Lotus	334	0	0	0	0	334
Mazda	251	0	0	0	0	251
McLaren	374	0	0	0	0	374
Mercedes	321	12	10	0	0	299
Mitsubishi	258	0	0	0	0	258
Nissan	266	3	4	0	0	260
Porsche	336	0	0	0	0	336
Subaru	264	0	2	0	0	262
Suzuki	273	0	0	0	0	273
Tesla	0	0	6	0	0	-6
Toyota	278	4	7	0	0	268
Volvo	318	0	10	0	0	307
Fleet Total	**294**	**8**	**7**	**0**	**0**	**279**

Note: Volkswagen is not included in this table due to an ongoing investigation. Based on the original compliance data, Volkswagen has a 2-cycle tailpipe value of 279 g/mi, an FFV credit of 8 g/mi, an A/C credit of 7 g/mi, a CH_4 and N_2O deficit of 2 g/mi, and a compliance value of 266 g/mi.

Table C-5. 2013 Compliance Values - Passenger Car Fleet (g/mi)

Manufacturer	2-Cycle Tailpipe	Credits (g/mi) FFV	Credits (g/mi) A/C	Credits (g/mi) Off-Cycle	CH_4 & N_2O Deficit	Compliance Value
Aston Martin	444	0	6	0	0	438
BMW	271	0	8	0	0	263
BYD Motors	0	0	0	0	0	0
Coda	0	0	0	0	0	0
Ferrari	475	0	10	0	0	465
Fiat Chrysler	289	12	10	0	0	268
Ford	256	9	7	0	0	240
GM	273	10	9	0	0	254
Honda	228	0	3	0	1	226
Hyundai	238	0	5	0	0	233
Jaguar Land Rover	345	3	5	0	0	337
Kia	252	0	5	0	0	247
Lotus	334	0	0	0	0	334
Mazda	232	0	0	0	0	232
McLaren	374	0	0	0	0	374
Mercedes	296	12	9	0	0	275
Mitsubishi	254	0	0	0	0	254
Nissan	232	0	4	0	0	228
Porsche	309	0	0	0	0	309
Subaru	254	0	1	0	0	253
Suzuki	266	0	0	0	0	266
Tesla	0	0	6	0	0	-6
Toyota	224	0	7	0	0	217
Volvo	292	0	10	0	0	282
Fleet Total	**251**	**4**	**6**	**0**	**0**	**241**

Note: Volkswagen is not included in this table due to an ongoing investigation. Based on the original compliance data, Volkswagen has a passenger car 2-cycle tailpipe value of 272 g/mi, an FFV credit of 7 g/mi, an A/C credit of 6 g/mi, a CH_4 and N_2O deficit of 2 g/mi, and a compliance value of 260 g/mi.

Table C-6. 2013 Compliance Values - Light Truck Fleet (g/mi)

Manufacturer	2-Cycle Tailpipe	Credits (g/mi) FFV	A/C	Off-Cycle	CH_4 & N_2O Deficit	Compliance Value
BMW	346	0	11	0	0	335
Fiat Chrysler	380	21	11	0	0	348
Ford	375	20	8	0	1	348
GM	395	22	9	0	0	364
Honda	312	0	5	0	0	307
Hyundai	317	0	7	0	0	310
Jaguar Land Rover	414	0	9	0	0	405
Kia	301	0	8	0	0	293
Mazda	296	0	0	0	0	296
Mercedes	371	12	12	0	0	347
Mitsubishi	267	0	0	0	0	267
Nissan	340	8	4	0	0	328
Porsche	363	0	0	0	0	363
Subaru	270	0	2	0	0	268
Suzuki	330	0	0	0	0	330
Toyota	347	8	7	0	0	332
Volvo	348	0	11	0	0	337
Fleet Total	**360**	**14**	**8**	**0**	**0**	**338**

Note: Volkswagen is not included in this table due to an ongoing investigation. Based on the original compliance data, Volkswagen has a light truck 2-cycle tailpipe value of 327 g/mi, an FFV credit of 15 g/mi, an A/C credit of 10 g/mi, a CH4 and N2O deficit of 1 g/mi, and a compliance value of 302 g/mi.

Appendix D: 2014 Model Year Report Credits and Deficits

Table D-1. 2014 Model Year Reported Credits and Deficits

Manufacturer	Pathway	Fleet	Credit Type	Fleet Average (g/mi)	Fleet Standard (g/mi)	Production Volume	Credits (Mg)
Aston Martin	TLAAS	Car	Fleet Average	454	324	1,272	(32,289)
			A/C Leakage			1,272	783
			A/C Efficiency			1,272	645
BMW	Primary	Truck	Fleet Average	312	313	81,938	18,507
			A/C Leakage			81,938	131,203
			A/C Efficiency			81,938	79,580
			Off-Cycle			81,938	113,537
			N2O Deficit				(10,847)
			CH4 Deficit				(1,365)
		Car	Fleet Average	256	258	297,388	116,138
			A/C Leakage			297,226	256,260
			A/C Efficiency			297,388	231,480
			Off-Cycle			297,388	183,103
			N2O Deficit				(37,167)
			CH4 Deficit				(4,677)
			Advanced Technology			9,895	
BYD Motors	Primary	Car	Fleet Average	0	261	50	2,548
			Advanced Technology			50	
Ferrari	TLAAS	Car	Fleet Average	484	324	2,301	(71,888)
			A/C Leakage				3,408
			A/C Efficiency				1,746
Fiat Chrysler	Primary	Truck	Fleet Average	345	327	1,446,365	(5,880,298)
			A/C Leakage			1,446,365	3,186,801
			A/C Efficiency			1,446,365	1,313,950
			Off-Cycle				2,361,453
			CH4 Deficit			316,255	(46,268)
		Car	Fleet Average	286	262	648,377	(3,038,512)
			A/C Leakage			633,882	1,113,855
			A/C Efficiency			633,065	526,044
			Off-Cycle				416,894
			CH4 Deficit			25,775	(755)
			Advanced Technology			3,404	

Table D-1. 2014 Model Year Reported Credits and Deficits

Manufacturer	Pathway	Fleet	Credit Type	Fleet Average (g/mi)	Fleet Standard (g/mi)	Production Volume	Credits (Mg)
Ford	Primary	Truck	Fleet Average	355	345	1,075,502	(2,429,183)
			A/C Leakage			1,075,502	1,846,942
			A/C Efficiency			1,024,234	597,121
			Off-Cycle				769,099
			N2O Deficit			28,307	(28,579)
			CH4 Deficit			498,539	(44,119)
		Car	Fleet Average	247	254	1,258,732	1,720,495
			A/C Leakage			1,258,732	1,412,435
			A/C Efficiency			876,873	518,730
			Off-Cycle				501,470
			N2O Deficit			6,041	(5,272)
			CH4 Deficit			259,189	(14,512)
			Advanced Technology			18,826	
GM	Primary	Truck	Fleet Average	350	357	1,164,610	1,841,312
			A/C Leakage			1,164,610	1,878,149
			A/C Efficiency			1,143,432	1,066,971
			Off-Cycle				457,702
			CH4 Deficit			786,583	(43,744)
		Car	Fleet Average	256	254	1,556,701	(607,935)
			A/C Leakage			1,552,552	1,918,074
			A/C Efficiency			1,454,276	950,133
			Off-Cycle				228,888
			N2O Deficit			10,575	(7,384)
			CH4 Deficit			192,022	(14,061)
			Advanced Technology			25,847	
Honda	Primary	Truck	Fleet Average	299	308	577,828	1,174,600
			A/C Leakage			577,828	400,850
			A/C Efficiency			577,828	288,562
			Off-Cycle			316,393	239,134
		Car	Fleet Average	228	250	868,337	3,730,209
			A/C Leakage			863,817	225,990
			A/C Efficiency			868,336	241,401
			Off-Cycle			792,892	164,811
			N2O Deficit				(224,693)
			Advanced Technology			1,635	
Hyundai	Primary	Truck	Fleet Average	325	301	38,441	(208,379)
			A/C Leakage			38,441	24,989

Table D-1. 2014 Model Year Reported Credits and Deficits

Manufacturer	Pathway	Fleet	Credit Type	Fleet Average (g/mi)	Fleet Standard (g/mi)	Production Volume	Credits (Mg)
			A/C Efficiency			38,441	33,274
			Off-Cycle			38,441	26,111
		Car	Fleet Average	247	253	509,920	597,414
			A/C Leakage			509,920	199,151
			A/C Efficiency			509,920	320,839
			Off-Cycle			424,458	59,075
Jaguar Land Rover	Primary	Truck	Fleet Average	334	317	26,103	(100,228)
			A/C Leakage				101,406
			A/C Efficiency				33,606
			Off-Cycle				32,693
	TLAAS	Truck	Fleet Average	382	401	29,130	125,010
			A/C Leakage				107,234
			A/C Efficiency				35,526
			Off-Cycle				36,477
		Car	Fleet Average	330	335	12,323	12,031
			A/C Leakage				15,850
			A/C Efficiency				12,478
			Off-Cycle				5,315
Kia	Primary	Truck	Fleet Average	330	312	28,757	(116,914)
			A/C Leakage			28,757	18,904
			A/C Efficiency			14,783	11,353
			Off-Cycle			18,801	3,428
		Car	Fleet Average	265	251	507,630	(1,387,706)
			A/C Leakage			478,225	208,197
			A/C Efficiency			507,627	322,330
			Off-Cycle			430,849	88,313
Lotus	TLAAS	Car	Fleet Average	338	300	280	(2,078)
Mazda	Primary	Truck	Fleet Average	287	300	78,826	231,452
		Car	Fleet Average	220	251	217,333	1,315,557
McLaren	TLAAS	Car	Fleet Average	372	319	279	(2,887)
Mercedes	Primary	Truck	Fleet Average	340	315	77,572	(438,020)
			A/C Leakage				123,285
			A/C Efficiency				93,551
			Off-Cycle				24,078
		Car	Fleet Average	274	257	271,031	(899,684)
			A/C Leakage				245,585
			A/C Efficiency				285,704
			Off-Cycle				139,554

Table D-1. 2014 Model Year Reported Credits and Deficits

Manufacturer	Pathway	Fleet	Credit Type	Fleet Average (g/mi)	Fleet Standard (g/mi)	Production Volume	Credits (Mg)
			Advanced Technology			3,610	
	TLAAS	Truck	Fleet Average	433	412	14,740	(69,914)
			A/C Leakage				15,669
			A/C Efficiency				17,978
			Off-Cycle				154
		Car	Fleet Average	284	315	7,095	42,947
			A/C Leakage				6,275
			A/C Efficiency				7,403
			Off-Cycle				4,295
Mitsubishi	Primary	Truck	Fleet Average	256	287	29,828	208,850
		Car	Fleet Average	224	236	60,679	142,181
			Advanced Technology			219	
Nissan	Primary	Truck	Fleet Average	327	318	389,639	(792,052)
			A/C Leakage				348,923
			A/C Efficiency				211,994
			Off-Cycle				214,182
		Car	Fleet Average	229	249	935,995	3,655,323
			A/C Leakage				414,968
			A/C Efficiency				542,001
			Off-Cycle				263,734
			Advanced Technology			10,339	
Subaru	Primary	Truck	Fleet Average	254	289	356,818	2,820,744
			A/C Efficiency				179,565
			Off-Cycle				1,045
		Car	Fleet Average	250	243	109,078	(149,093)
			A/C Efficiency				30,379
Tesla	Primary	Car	Fleet Average	0	288	17,791	1,000,495
			A/C Efficiency				19,801
			Advanced Technology			17,791	
Toyota	Primary	Truck	Fleet Average	343	326	772,809	(2,967,359)
			A/C Leakage				720,037
			A/C Efficiency				544,436
			Off-Cycle				567,623
		Car	Fleet Average	221	250	1,420,641	8,044,601
			A/C Leakage				1,045,084
			A/C Efficiency				1,284,578
			Off-Cycle				578,927

Table D-1. 2014 Model Year Reported Credits and Deficits

Manufacturer	Pathway	Fleet	Credit Type	Fleet Average (g/mi)	Fleet Standard (g/mi)	Production Volume	Credits (Mg)
			Advanced Technology			1,218	
Volkswagen	Primary	Truck	Fleet Average	320	311	103,524	(210,442)
			A/C Leakage				155,288
			A/C Efficiency				121,759
			N2O Deficit				(18,499)
			CH4 Deficit				(922)
		Car	Fleet Average	256	250	487,086	(570,662)
			A/C Leakage				423,705
			A/C Efficiency				376,957
			N2O Deficit				(120,381)
			CH4 Deficit				(44,575)
			Advanced Technology			755	
Volvo	Primary	Truck	Fleet Average	348	307	15,063	(139,490)
			A/C Leakage				24,902
			A/C Efficiency				2,854
		Car	Fleet Average	288	258	16,526	(96,808)
			A/C Leakage				20,330
			A/C Efficiency				4,517